# Ferriday's Map Book of

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# World Geography

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# A Map Book of World Geography

A. FERRIDAY, M.Sc.
*Senior Master at*
*Okehampton Grammar School*

~~1807~~

MACMILLAN
London · Melbourne · Toronto
ST MARTIN'S PRESS
New York
1966

Library

© A. Ferriday 1966

First Edition 1946
Reprinted 1947, 1948, 1950, 1953, 1956, 1958
Second Edition 1961
Reprinted 1964
Third Edition 1966

MACMILLAN AND COMPANY LIMITED
*Little Essex Street London WC 2*
*also Bombay Calcutta Madras Melbourne*

THE MACMILLAN COMPANY OF CANADA LIMITED
*70 Bond Street Toronto 2*

ST MARTIN'S PRESS INC
*175 Fifth Avenue New York NY 10010*

[illegible]
Date 26.10.2007
Acc. No. 12768

*Printed in Great Britain by*
*Richard Clay (The Chaucer Press), Ltd.,*
*Bungay, Suffolk*

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# Preface

THIS book is designed to provide a course of World Geography for pupils of 15 years and over.

The plan is similar to that adopted in other books of this series in that the text faces the maps and diagrams designed to illustrate it.

The scheme is clear from the list of contents: (1) the distribution and character of land forms and the processes which modify them, (2) the climates of the world, (3) the vegetation belts, (4) a number of topics of special importance.

*1961* A. F.

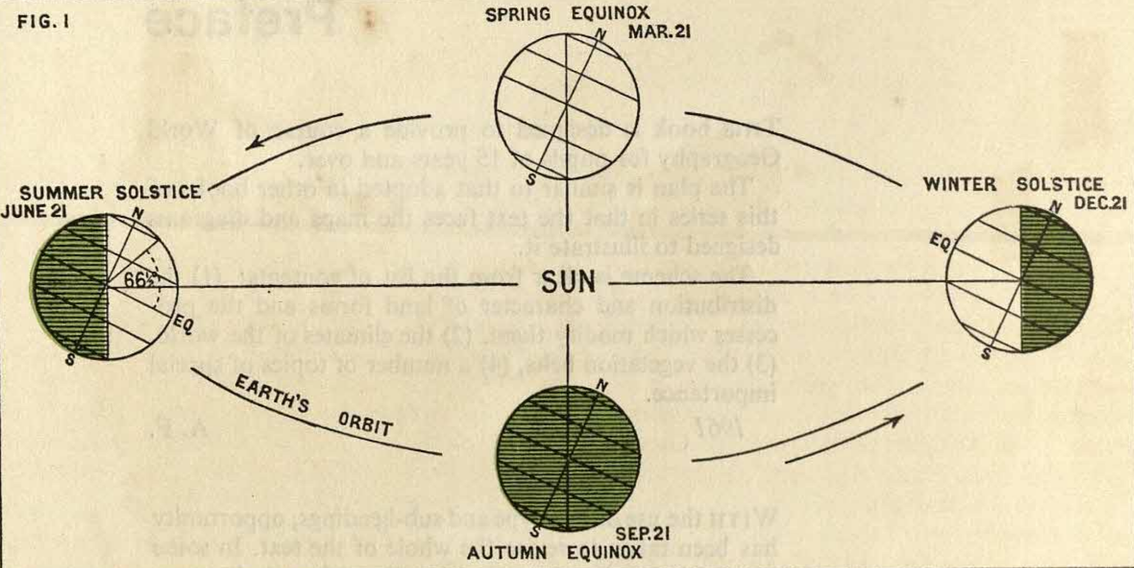
WITH the use of new type and sub-headings, opportunity has been taken to revise the whole of the text. In some cases this has involved the rewriting of a whole page; in others, parts of a page.

°C. have been included as well as °F.

*1966* A. F.

# Latitude, Longitude, Time, the Seasons

FIG. 1



LATITUDE IS ANGULAR DISTANCE N. OR S. OF EQUATOR

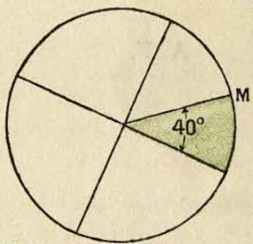


FIG. 2 M is 40° N.

LONGITUDE IS ANGULAR DISTANCE E. OR W. OF GREENWICH

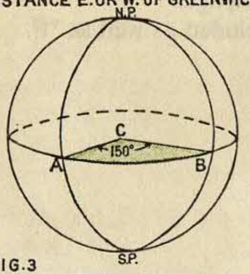


FIG. 3

LAT. AND LONG. GIVE POSITION:- X IS 35° N. 20° W.

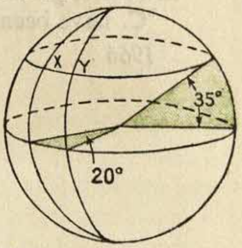


FIG. 4

GREAT CIRCLES

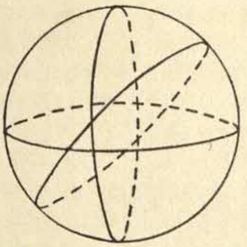
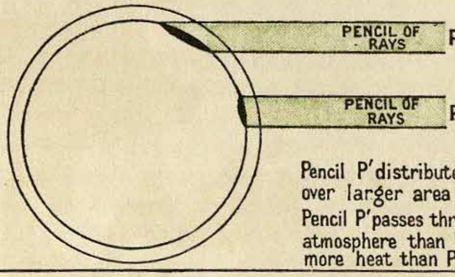


FIG. 5

FIG. 6



Pencil P′ distributes itself over larger area than P

Pencil P′ passes through larger atmosphere than P and loses more heat than P

FIG. 7

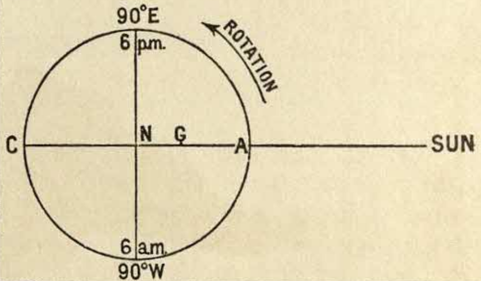
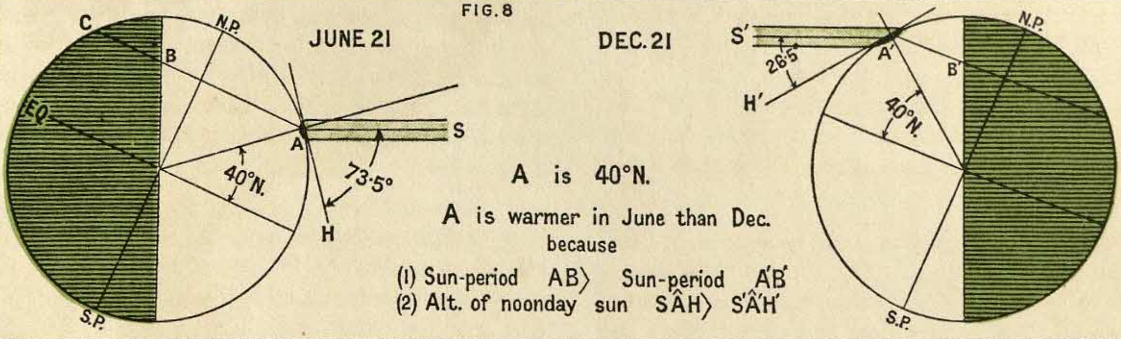


FIG. 8



A is 40°N.

A is warmer in June than Dec. because

(1) Sun-period AB > Sun-period A′B′

(2) Alt. of noonday sun SÂH > S′Â′H′

# Latitude, Longitude, Time, the Seasons

**LATITUDE AND LONGITUDE.** Lines of latitude and longitude are drawn on the globe to fix the position of places. Lines of longitude are circles passing through the poles and dividing the globe into hemispheres. Lines of latitude are circles equidistant from the Equator and are therefore at right-angles to lines of longitude. Lines of longitude are also called meridians, since all places on a particular meridian have noon at the same time. The meridian passing through Greenwich is known as the Prime Meridian; its continuation on the other side of the globe is 180°. Places east of Greenwich have eastern longitude, e.g. in Fig. 3, *A* is a place on the Equator and on 0° longitude, *B* is on the Equator east of *A*, and since the angle made by joining *A* and *B* to the centre of the earth at *C* is 150°, then *B* is 0° latitude, 150° E. longitude. Similarly in Fig. 4, if *Y* is on line of latitude 35° N. and also on the Prime Meridian, then since *X* is 20° W. of the Prime Meridian, the position of *X* is 35° N., 20° W. All circles drawn on the globe which divide it into hemispheres are called Great Circles. Obviously all meridians are Great Circles, as is the Equator, but all other parallels of latitude are not. Obviously, too, we can have Great Circles which do not pass through the poles (Fig. 5). They are important as air and sea routes since they are the shortest distances between any two points.

**THE DATE LINE.** The Date Line is 180° longitude for the most part, but diverges from it at one or two points. When this line is crossed travelling westwards a day is missed, so that if it is June 21 on arrival, the next day is June 23. Similarly, when travelling eastwards a day is added, so that if it is June 21 on arrival, the next day is also June 21. Since meridian 180° passes through a number of island groups, the Date Line is made to diverge from it so as to avoid them, e.g. it passes between the Samoan and Fiji Islands and Fiji is thus a day ahead of Samoa.

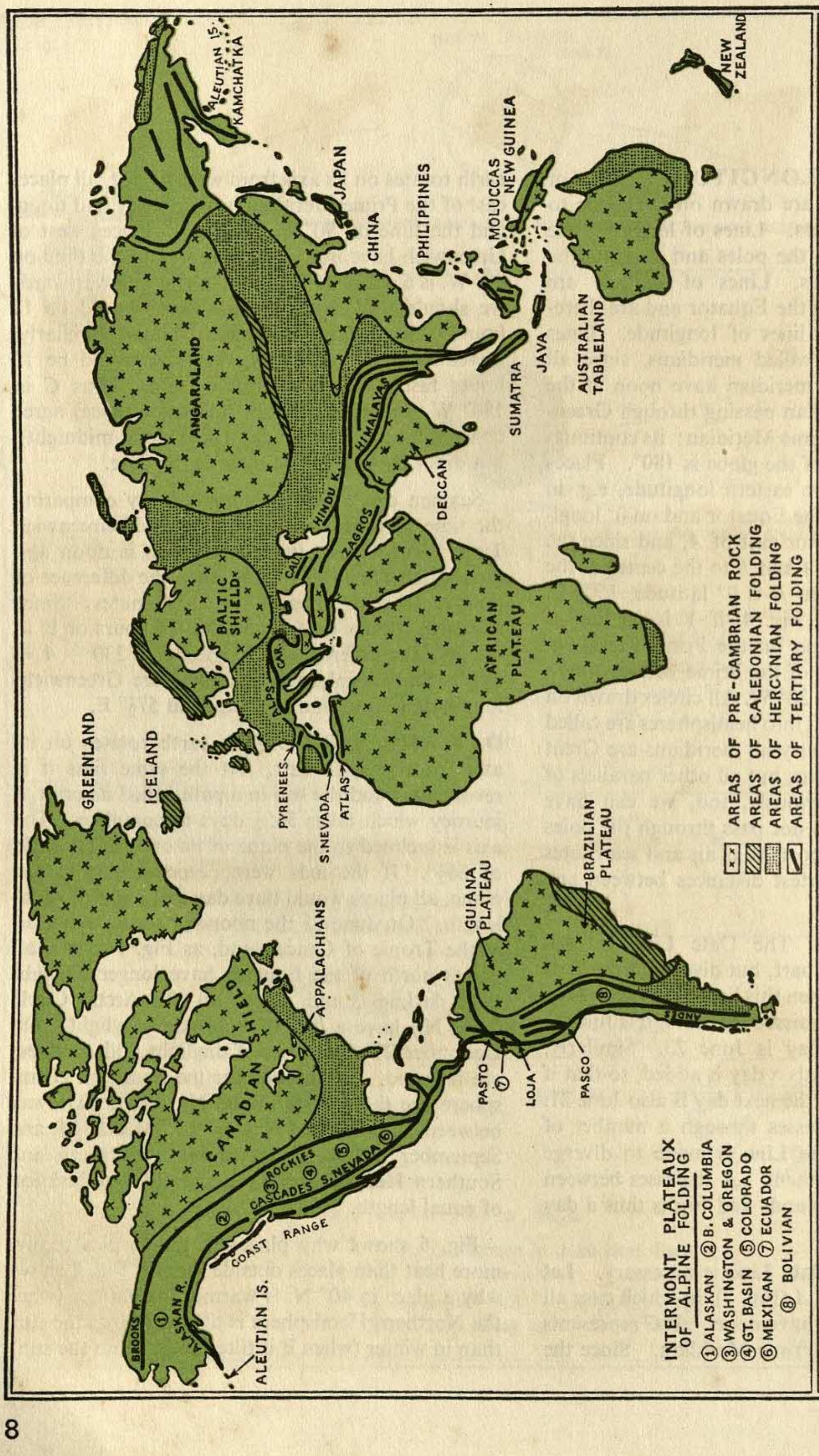
Consider why the Date Line is necessary. Let the sun be overhead at *A* (Fig. 7), in which case all places on meridian *AN* have noon. If *G* represents Greenwich, this is the Prime Meridian. Since the earth rotates on its axis from west to east, all places east of the Prime Meridian have already had noon, and the time on 90° E. is 6 p.m. Places west of Greenwich have not yet had noon and the time on 90° W. is 6 a.m. If we travel to *C* going westwards we should find that the time there would be 12 hours slower than Greenwich Time. Similarly, travelling to *C* eastwards, the time would be 12 hours faster than Greenwich Time. Thus *C* in 180° W. and *C* in 180° E. (the same place) agree concerning the time of day (12 o'clock midnight), but differ by one day as regards the date.

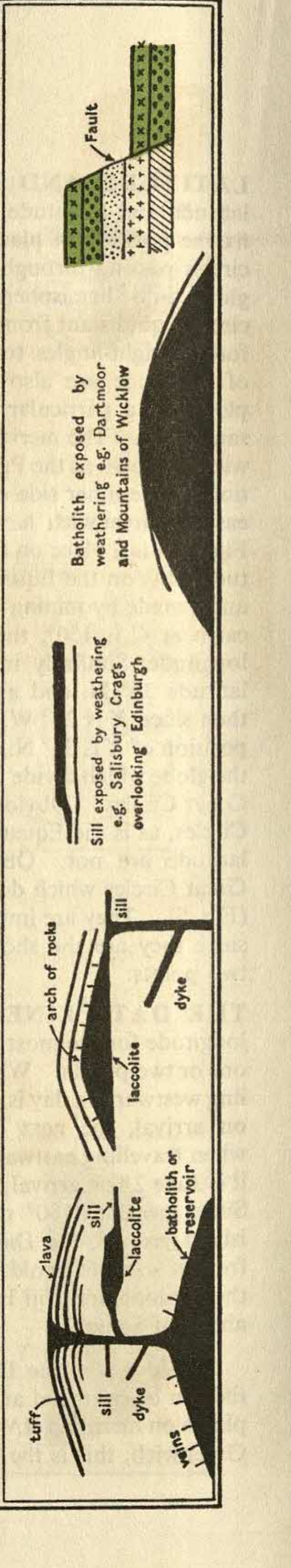
Seamen can find their longitude by comparing the time of their position with that of Greenwich Time. Thus if the time by the sun is noon and Greenwich Time is 8.10 a.m., then the difference of time is 3 hours 50 mins. = 230 minutes. Since the earth rotates through 360° in 24 hours or 1° in 4 mins., the difference of longitude = 230 ÷ 4 = 57½°. Since local noon occurs before Greenwich, longitude is east, and the ship is in 57½° E.

**DAY AND NIGHT.** The earth rotates on its axis from west to east. At the same time it is revolving round the sun in a path called its orbit, a journey which takes 365¼ days to complete. The axis is inclined to the plane of its orbit at an angle of 66½°. If the axis were perpendicular to the plane, all places would have day and night of equal length. On June 21 the noonday sun is overhead at the Tropic of Cancer, and, as Fig. 1 shows, all places north of the Equator have longer daylight than darkness, and places on the Arctic Circle (66½° N.) have a day of unbroken daylight. On December 21 conditions of daylight and darkness are reversed. Conditions for the Southern Hemisphere are the reverse of the Northern. Midway between summer and winter, i.e. March 21 and September 21, all places in both Northern and Southern Hemispheres have daylight and darkness of equal length.

Fig. 6 shows why places in the tropics receive more heat than places outside them. Fig. 8 shows why a place in 40° N. is warmer in summer (when the Northern Hemisphere is tilted towards the sun) than in winter (when it is tilted away from the sun).

# Mountains and Plateaux




tuff
veins
sill
dyke
lava
sill
laccolite
batholith or reservoir
arch of rocks
laccolite
sill
dyke
Sill exposed by weathering e.g. Salisbury Crags overlooking Edinburgh
Batholith exposed by weathering e.g. Dartmoor and Mountains of Wicklow
Fault

# Mountains and Plateaux

**Mountain-building** appears to take place at intervals. The building period is followed by a period of rest during which weathering agents seek to reduce it to a plain, but long before this is achieved, a new mountain-building period or orogenesis starts.

Little is known about the Pre-Cambrian Era. Its rocks form the bases of the continents and are exposed in the Canadian, Baltic, and Angara 'Shields', and in the tablelands of Guiana, Brazil, Africa, India, and Australia. The **Caledonian** orogenesis was responsible for the highlands of Scotland, Cumbria, and North Wales, all characterized by a north-east to south-west grain. The **Hercynian** or **Armorican** produced the mountains of Devon and Cornwall, South Wales and south-west Ireland. A later movement, the **Alpine Storm**, gave rise to mountains, at present the highest in the world, which extend from Switzerland to the Himalayas and which girdle the Pacific Ocean (p. 8).

**VULCANICITY.** Volcanic activity always accompanies crustal movements. Around the Pacific there is a 'fiery girdle' of Tertiary date extending by way of the Andes, Rockies, Aleutians, Kamchatka, Japan, the Philippines, New Guinea, and New Zealand to Mount Erebus in Antarctica. Others occur (*a*) from the Moluccas to Sumatra, (*b*) in the Mediterranean, e.g. Vesuvius, Lipari, Etna, (*c*) close to the African Rift Valley, and (*d*) in Iceland.

**TYPES OF MOUNTAIN.** Mountains can therefore be divided into **fold mountains** and **volcanoes.** The name 'young fold mountains' is given to those of Alpine origin, 'old folds' to the Hercynian and Caledonian. Volcanic cones include the cinder type like Monte Nuova near Naples and Raudhholar in Iceland, lava types like those of Hawaii and France's Massif Central, composite types (i.e. those with several cones) such as Stromboli and Etna, and calderas (i.e. where the original cone has been blown away) such as Askja in Iceland and the Crater Lake of Oregon.

**IGNEOUS INTRUSIONS.** Magma which fails to reach the surface, cools, and is later exposed by weathering, is known as intrusive rock. Giant reservoirs of unknown depth are known as batholiths, e.g. Dartmoor and the Wicklow Mountains. Magma which forces its way across the bedding-planes along fissures forms dykes as in Mull, Arran, and adjacent mainland areas; that which travels as sheets along the bedding-planes forms sills as in the Great Whin Sill of Northumberland and the Salisbury Crags of Edinburgh; and that which swells up between the bedding-planes as cake-like masses becomes laccolites, as instanced by the Black Cuillins of Skye and Traprain Law of East Lothian.

**VOLCANIC SOILS.** Lavas weather into soils frequently rich in plant foods, as instanced by those of the north-west Deccan rich with cotton-fields, the terra roxa of Brazil, a major factor in that country's coffee production, the soils of Java used for the cultivation of a wide variety of tropical produce, and the slopes of Vesuvius and Etna clothed with farming villages.

**PLATEAUX.** The term 'plateau' is given to an elevated and comparatively flat surface, though dissection by the agents of denudation frequently obliterates the original plateau surface.

They can be divided into:

(*a*) **blocks** which have either been raised bodily as illustrated by the Alston and Askrigg Blocks of the Pennines, tilted to present a steep scarp in the west, or blocks sometimes known as horsts which have been left upstanding by the collapse of adjacent surface areas, such as the Vosges and Black Forest on either side of the Rhine Rift Valley;

(*b*) **intermont plateaux** occupying areas between fold mountains, e.g. the Great Basin between the Rockies and Sierra Nevada and the Colombian Plateau between two Andean ranges;

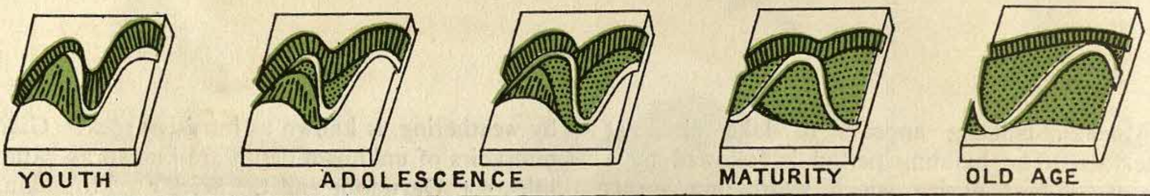
(*c*) **fold-mountain plateaux** formed by the denudation of fold mountains, e.g. the Scandinavian fjeld and the Scottish Highlands; and

(*d*) **volcanic plateaux** formed by the gentle flow of lava from numerous fissures, such as the plateaux of Antrim, Columbia–Snake and the north-west Deccan.

# The Work of Rivers

FIG. I

BLOCK DIAGRAMS SHOW LATERAL CUTTING BY RIVER



YOUTH

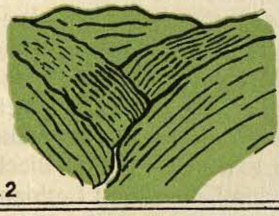


FIG. 2

MATURITY

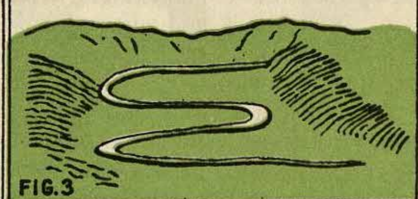


FIG. 3

OLD AGE

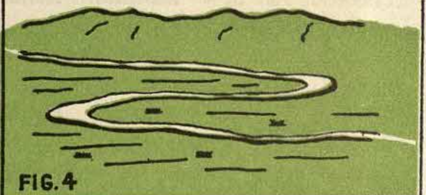


FIG. 4

REJUVENATED RIVER
— INCISED MEANDERS

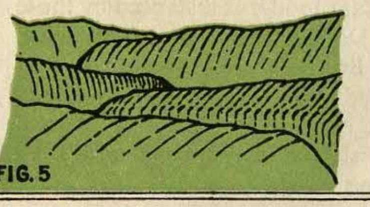


FIG. 5

RIVER WORK IN ARID LANDS
— CANYONS

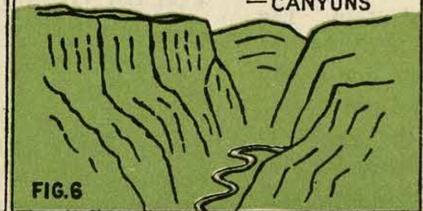


FIG. 6

ALLUVIAL CONES
— PIEDMONT PLAINS

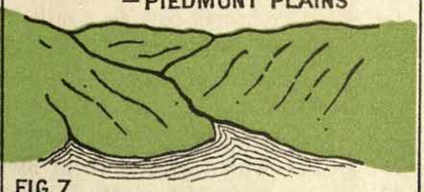


FIG. 7

RIVER TERRACES.
GRAVEL SITES VALUABLE
FOR HUMAN SETTLEMENT
E.G. RHÔNE

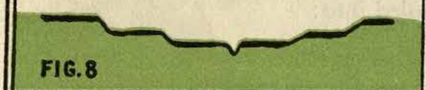


FIG. 8

FORMATION OF RAPIDS.
STAGE I SHOWS SECTION OF RIVER BED BEFORE EROSION
STAGE II SHOWS EROSION OF SOFTER ROCKS LEAVING UNEVEN BED.
THERE ARE SIX CATARACTS IN NILE. DURING DRY SEASON PARTS OF BED ARE EXPOSED AS ROCKY ISLETS. IN WET SEASON WATER TEARS MADLY OVER ROCKY OBSTRUCTIONS.

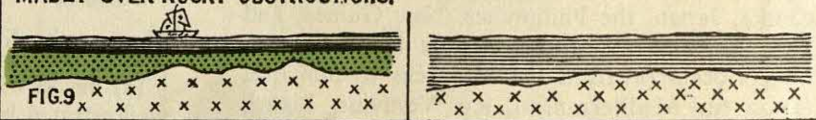


FIG. 9

OXBOW LAKE FORMED IN
FLOOD PLAIN

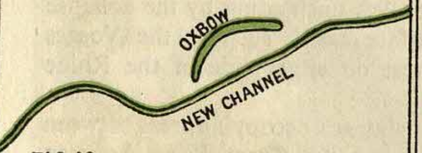


FIG. 10

RIVER CAPTURE

BEFORE CAPTURE

AFTER CAPTURE

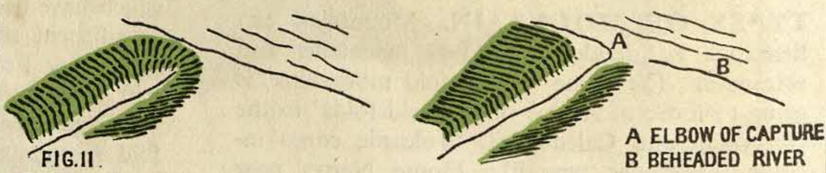


FIG. 11

A ELBOW OF CAPTURE
B BEHEADED RIVER

POT HOLES AB EXPOSED WHEN
RIVER IN LOW WATER

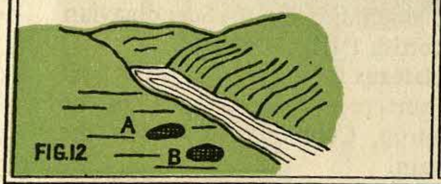


FIG. 12

RIVER CAPTURE BY A SUBSEQUENT

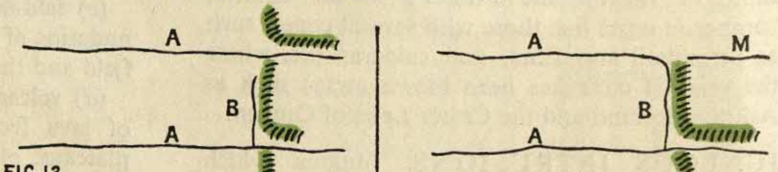


FIG. 13

M IS MISFIT OR BEHEADED RIVER

On the average, rock may be taken to be about 2½ times as dense as water, but when a solid is immersed in water the upthrust exerted by the water reduces its weight by from one-half to one-third its weight in air. Thus it becomes clear why even large boulders can be carried along by a stream and be employed in eroding its bed, especially in times of flood when the volume and velocity of water is increased and when the moving fragments acquire kinetic energy.

**YOUTH.** Erosion is greatest in the torrent track where the gradient is steepest and where swift-flowing tributaries increase the volume. Even boulders which cannot be carried along may be rocked to erode the bed immediately beneath them and form pot-holes. Coalescence of several pot-holes — effected by their increase in size and consequent approach to one another — results in a general lowering of the bed. This process of down-cutting is known as corrasion, and if this were the only process at work a youthful river would flow in a deep gorge. This is true of rivers in arid lands, the Grand Canyon of the Colorado for instance, but in other areas weathering causes valley sides to crumble and the valley acquires a V-shaped cross-section.

**ADOLESCENCE.** As a river rounds a bend, the force of the current is flung against the outer valley wall and undercuts it to produce a meander scar. Water on the inner bank is slacker and a gentle spur develops. The valley remains V-shaped, but at the point where the river curves, one side of the V is steeper than the other, and at the next curve the other side is steeper. The process of cutting its banks is known as lateral cutting. In this way the valley is widened and this stage is sometimes referred to as adolescence.

**MATURITY.** The next stage is the gradual destruction of the spurs effected by the river moving downstream, as shown in Fig. 1, until eventually the stage is reached where spurs are considerably blunted and eventually disappear. The river swings from one valley wall to the other in broad sweeps with valley flats lying within each meander — a stage known as maturity. Here one can stand in the valley floor and view a long stretch of the river uninterrupted by the interlocking spurs of youth. Tributary streams enter more gently; they too have developed flats like those of the main stream and have a cross-section more like a trough than a V.

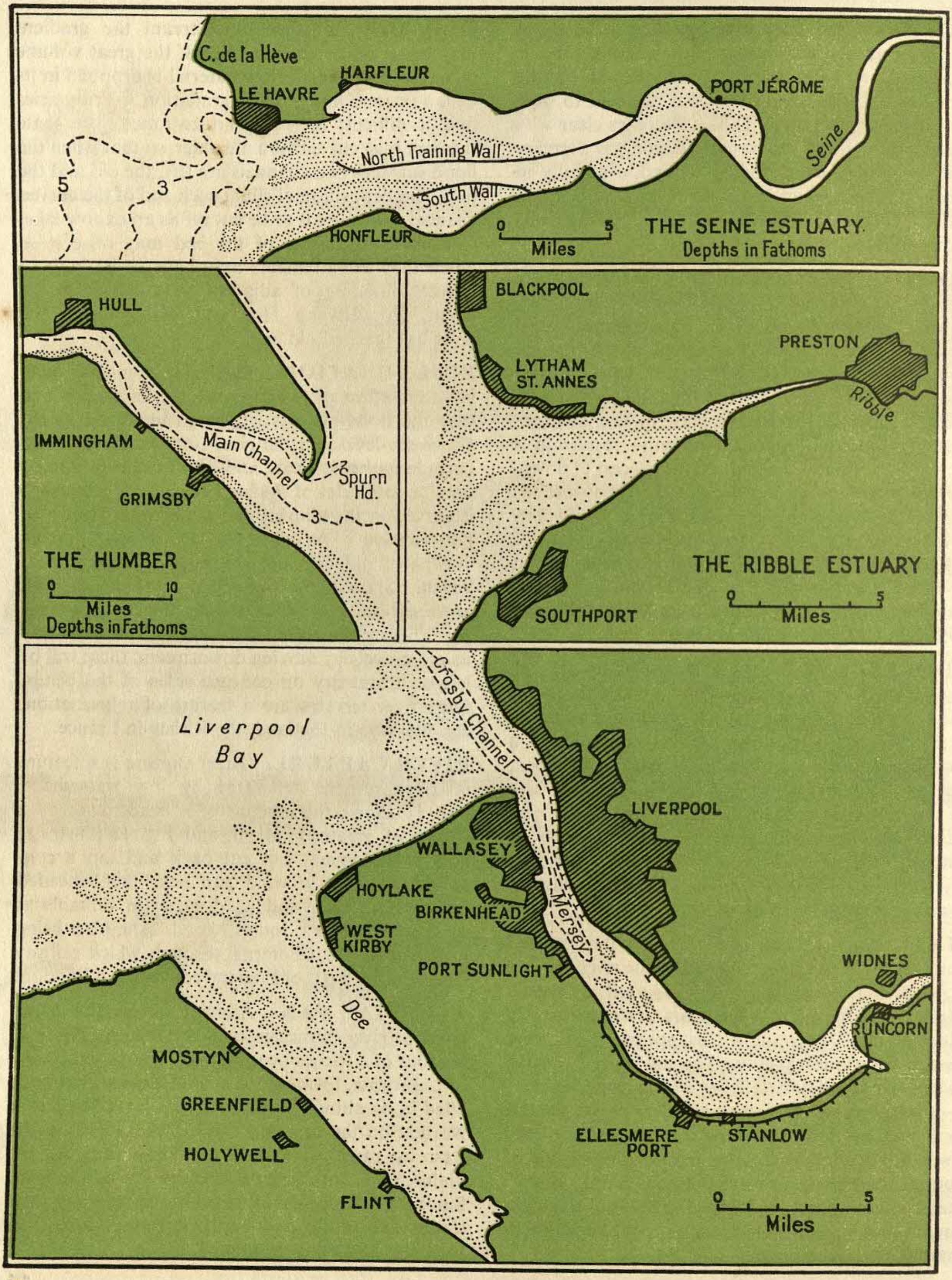
**OLD AGE.** Further downstream the gradient may be so gentle that in spite of the great volume of water, fine transported material is dropped in its bed, a process known as aggradation. Tributaries find it difficult to effect an entrance. In spate the river may cut across a meander, so that when the flood subsides two channels are left, the old and the new, and deposition of silt at each end of the curved channel will cause it to be cut off as an oxbow lake. Continued aggrading of the bed may raise it so much that embankments may have to be built to prevent flooding of adjacent flats — witness the Trent, Po, Hwang Ho, and Mississippi. The river has reached old age.

**REJUVENATION.** Earth movements may have the effect of lowering the sea-level, in which case the flood-plain is left at an increased height above sea-level and the river once more begins to corrade its bed. Scars and spurs begin to appear on alternate sides of the big sweeps as a new valley is carved in the alluvial plain, a process known as rejuvenation. A rejuvenated valley has the big sweeps of old age and the interlocking spurs of youth. Should the sea-level continue to fall, rejuvenation will begin again, and if this takes place before the river has had time to sweep away its old gravels by moving downstream, these will be left high and dry on concave sides of the bends. Such river terraces are a feature of rejuvenation, e.g. the Wye in England, the Rhône in France.

**RIVER CAPTURE.** River capture is a feature of river systems separated by low watersheds. Fig. 11 shows the capture of a headstream by a stream of greater gradient, and Fig. 13 illustrates how a subsequent can cut back and tap a consequent, leaving a wind gap near the beheaded river. Both river and wind gaps are valuable as road and railway routes, good examples being provided by the Chilterns, through which railway lines from all parts of England converge on London.

**ALLUVIAL FAN.** Alluvial fan is the name given to river-borne material dropped by rivers at the foot of a steep slope (Fig. 7). The Great Valley of California, formerly an arm of the sea, has been filled in by alluvial fans. Streams leave the Sierra Nevada on the east and the Coast Ranges on the west by canyons, and spread their fans on the plains, each fan merging into the fan of the next. Since the fans consist of water-borne material, their slopes are gentle and easily irrigated, and their soils soft and easily ploughed.

# Estuaries


C. de la Hève
HARFLEUR
LE HAVRE
PORT JÉRÔME
Seine
North Training Wall
South Wall
HONFLEUR
5
3
1
0
5
Miles
THE SEINE ESTUARY
Depths in Fathoms
HULL
IMMINGHAM
Main Channel
Spurn Hd.
GRIMSBY
3
THE HUMBER
0
10
Miles
Depths in Fathoms
BLACKPOOL
LYTHAM ST. ANNES
PRESTON
Ribble
SOUTHPORT
THE RIBBLE ESTUARY
0
5
Miles
Liverpool Bay
Crosby Channel
5
LIVERPOOL
WALLASEY
HOYLAKE
BIRKENHEAD
WEST KIRBY
Mersey
PORT SUNLIGHT
WIDNES
RUNCORN
Dee
MOSTYN
GREENFIELD
HOLYWELL
FLINT
ELLESMERE PORT
STANLOW
0
5
Miles

# Estuaries

The term **estuary** is given to the lower part of a tidal river which has only one outlet. The shape of the estuary depends on the nature of the relief before subsidence.

When a river reaches the sea, its current slackens, because of the mixing of river water with a much greater volume of sea water. Since an estuary is tidal, and since the ebb tide is usually stronger than the flood tide, reinforced as it is by the fresh-water discharge, sediment, instead of being dropped in the river mouth, is carried some distance out to sea, or if an offshore current exists, to some point along the coast.

**NAVIGABILITY.** The navigability of an estuary depends upon the nature of the outlet, the range of the tide, the distance upstream to which the tide can penetrate, the availability upstream for the accommodation of flood water, and the presence of obstructions in the bed which impair tidal scouring, and which in conjunction with high tidal range and narrowing estuary may produce bores. Shifting sandbanks are typical of winding estuaries because the position at which a shoal is left by the ebb tide is different from the position at which it is left by the flood tide. The shoal, somewhere in midstream, tends to be moved by each successive tide.

**SILTING OF ESTUARIES.** In wide estuaries such as those of the Dee, tidal currents are unable to prevent silting; in funnel-shaped estuaries such as the Thames, scouring is easier; and in bottle-necked estuaries such as the Mersey, water rushes violently in and out of the neck, between the capacious inner basin and the sea. The rise of Liverpool and the decay of Chester were due in part to the nature of their outlets. The twisting channel of the Humber brings deep water first to the Lincolnshire bank and then to the Yorkshire bank. This was of little consequence when Hull and Grimsby were used by vessels of shallow draught, but when steamers became bigger, Grimsby was at a disadvantage, because the deep channel passed it by. This explains the rise of Immingham as Grimsby's deep-water harbour, some distance upstream where the deep-water channel reaches the Lincolnshire bank.

**TIDAL RANGE.** The range of the tide is the vertical difference between high and low tide. In the open ocean this is only a few feet, but when the tidal wave enters a shallow sea, the shelving floor exerts friction, thereby reducing the velocity of the front of the wave. The pressure of the water behind causes the water to pile up, so that the height of the wave increases. Such an increase in tidal range occurs on the continental shelf, and this is increased as the water enters tapering inlets, partly because of the tapering and partly because of the shallowing floor. The highest tides in the world are experienced in the Bay of Fundy and the Bristol Channel. Such conditions present problems to ports such as Avonmouth. A ship discharging cargo at high tide may be many feet below the quayside a few hours later.

**BORES.** Bores are experienced in some tidal rivers. The presence of the Severn bore has prevented Gloucester from becoming a major port. Their presence, however, is not due entirely to an increasing shallowness upstream, but to a delicate balance of conditions, of which inequalities in the bed appears to be one.

**ARTIFICIAL IMPROVEMENTS.** These are usually necessary in estuarine harbours, and take the form of dredging and construction work. The ebb channel is the one chosen for improvement. Training walls, for instance, are frequently built to concentrate the waters into a single channel, as in the Seine and Ribble. These increase tidal scour within the walls, but foster the accumulation of material beyond them. The flood tide washes some of the sand from the flats back into the channel which the ebb tide may be unable to remove completely. The success of these improvements depends upon local conditions. Training walls failed to arrest the decay of Chester. On the other hand, the use of walls, breakwaters, and jetties, by directing the current to points where sludge tends to collect, enables a channel in the Clyde to be maintained for ocean-going vessels as far as Glasgow. The Seine bore is only encountered in short sections of the river since training walls were built in 1780.

# Deltas

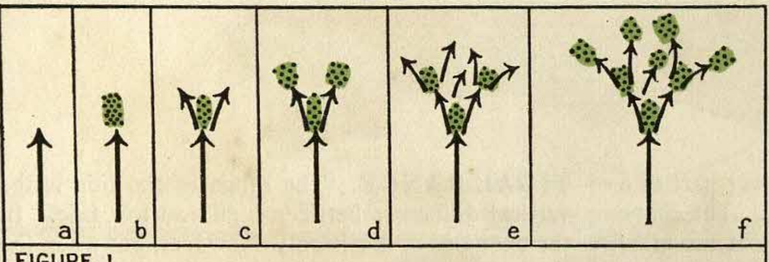


FIGURE 1

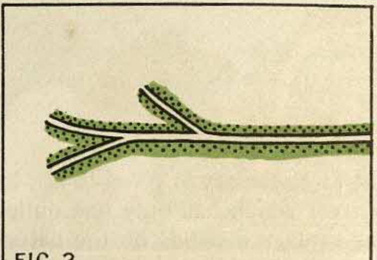


FIG. 2

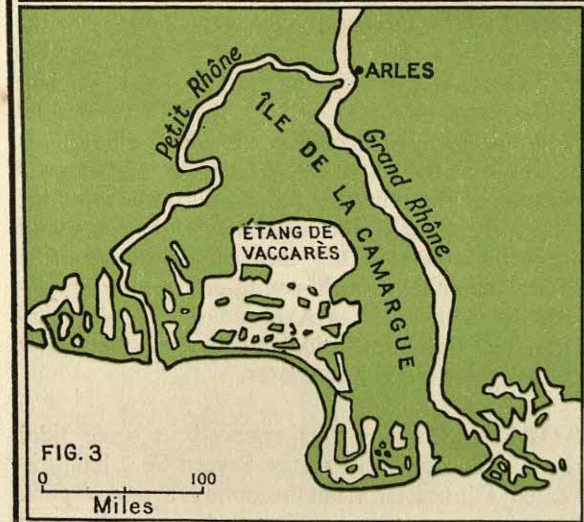


FIG. 3

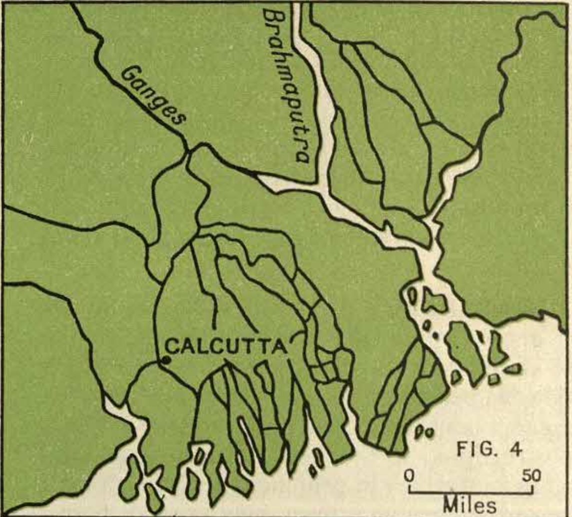


FIG. 4

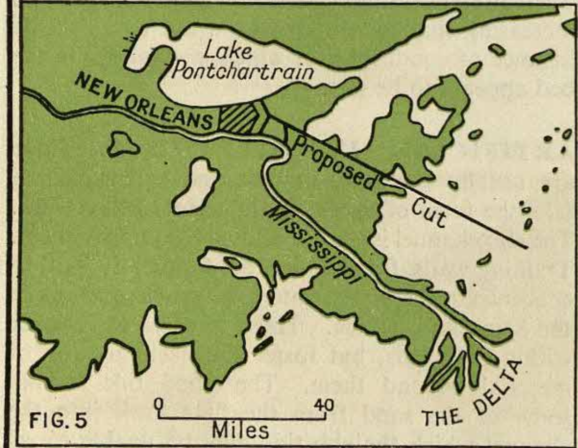


FIG. 5

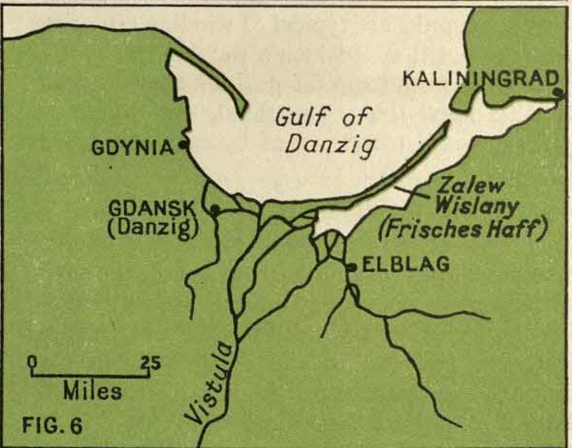


FIG. 6

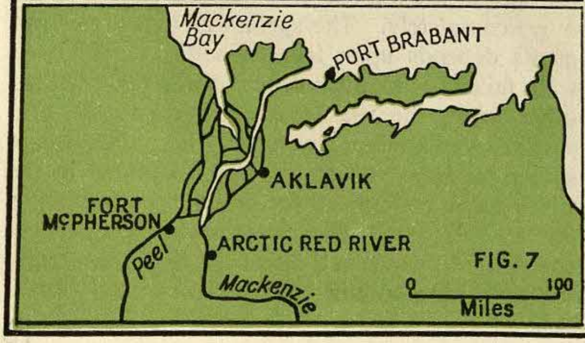


FIG. 7

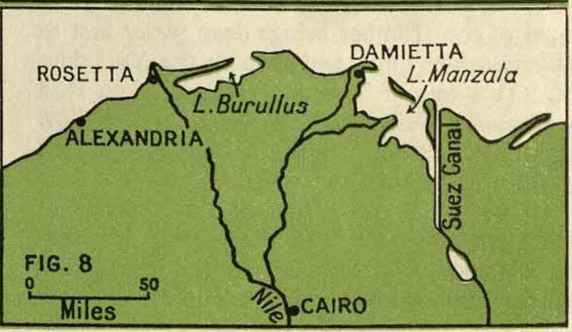


FIG. 8

# Deltas

Some rivers reach the sea by several mouths. To the land enclosed by these the term **delta** is given.

**FORMATION.** A delta is formed where tidal range is small. The ebb tide may be sufficiently powerful to roll coarse sediments to the river mouth. As more sediment is brought forward the bank becomes longer, and as more material slides down its sides, broader. In time, the bank is large enough to check the current itself (Fig. 1*b*) and the current divides (1*c*). The process of deposition (1*d*) and bifurcation (1*e*) is repeated. During particularly high tides, more deposition occurs, so that when the level of water is back to normal, the banks are left above the surface. Vegetable matter collects, and with its accumulation and decay the banks can remain above the highest water mark.

Old rivers, however, usually drop their coarser material in their beds. Only the finest sediment reaches the sea. Since sea water is saline, the particles are made to coagulate, more especially when they consist of clay, though less effectively than when they are siliceous or calcareous. Deposition is greatest on the edges of the current because here the water is freshest, i.e. narrow banks are built on each side of it (Fig. 2), and in time these may be raised above flood-level. Since fresh water can no longer mingle with saline water until it reaches the end of the embankments, the muddy tongue is extended out to sea. During heavy floods the banks may be pierced, and new channels formed, or a lagoon may be formed as two banks converge.

**DELTAIC SHAPES.** Local conditions determine whether the delta is forked like that of the Ganges or goose-footed like that of the Mississippi. An offshore current can also drift silt across the mouths, producing a smooth outline as in the case of the Nile or Vistula. In some cases, too, a river may simply be infilling a depression in which mounds of higher ground already exist, as in the case of the Mackenzie.

**DELTAIC PORTS.** Deltas are less satisfactory for the sites of ports than estuaries, but a valuable hinterland may demand their presence, as in the case of Calcutta for the Plain of Hindustan, Abadan for Persian oil, and New Orleans for the Mississippi Basin. Construction works and dredging are necessary, but the problem is complicated when the fresh-water discharge varies with the season, as in the case of the Hooghly below Calcutta.

Their sites are not ideal. In New Orleans, for instance, building construction is difficult because of the soft ground and high water-table, disease is promoted by the humid climate and marshy soils, flooding can only be avoided by levees, and sewage must be discharged into Lake Pontchartrain, since the alternative is to pump it into a river already full. Moreover, the circuitous channel to the sea is 110 miles long. An artificial channel, 70 miles long, is under construction.

A contrast is provided by deltas which open to Arctic seas. Where these are navigable and the hinterland sufficiently productive, a port may develop, as the Yenisei's Igarka for the shipment of timber, even though its use is confined to the short summer. The Mackenzie, however, is only navigable by flat-bottomed craft, and transhipment is necessary at Port Brabant on the open sea.

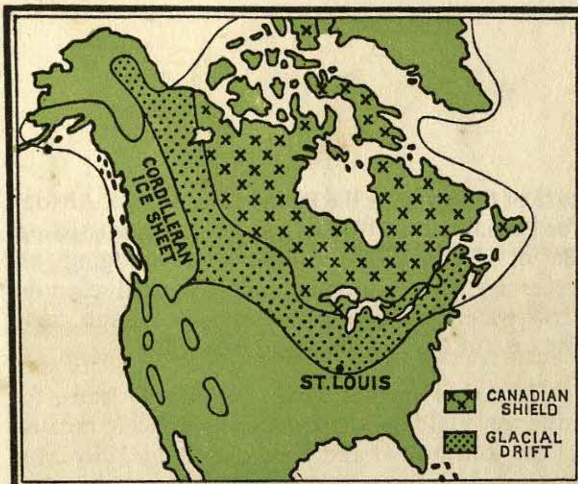
**AGRICULTURAL VALUE OF DELTAS.** They frequently provide fertile soils which can be cultivated, as instanced by the Ganges, which has a virtual monopoly of the world's jute (p. 51), the Hwang Ho, which supports one of the world's densest populations, and the Nile, where cotton, rice, and other crops are grown.

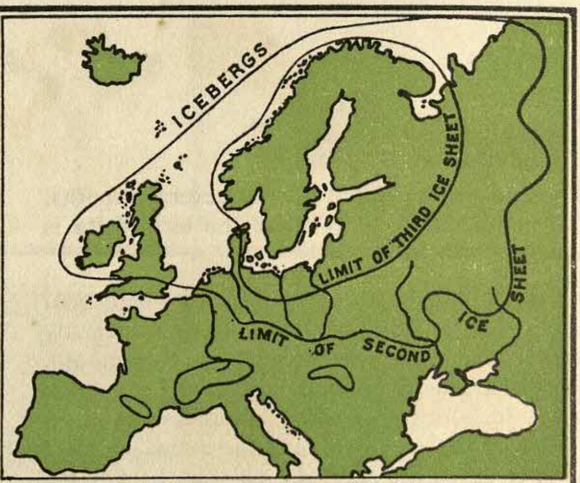
On the other hand, excessive flooding may prove a deterrent, as in the case of the Ganges, or may make their cultivation impossible, as instanced by the swamp forests of the Niger and Orinoco, or that of the Indus which is flooded in the wet season.

Some deltas are stony and their use is limited, as in the case of the Rhône, which is used for grazing.

Climate also limits the use of Arctic deltas because the ground is frozen for long periods. The Mackenzie can only be used to a limited extent for the grazing of dairy cattle during the short summer, for the supply of milk to its isolated settlements.

# The Work of Ice





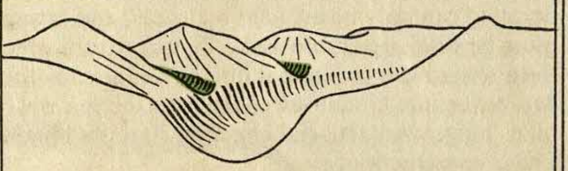
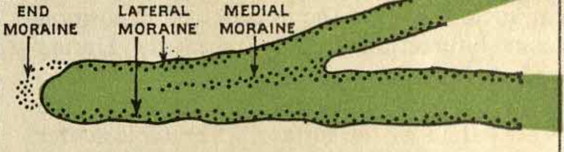
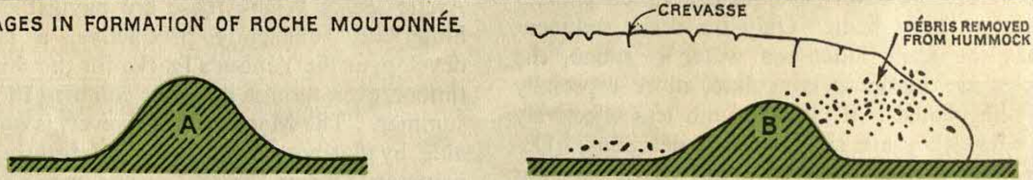


DIAGRAM SHOWING HANGING VALLEYS JOINING MAIN GLACIAL VALLEY



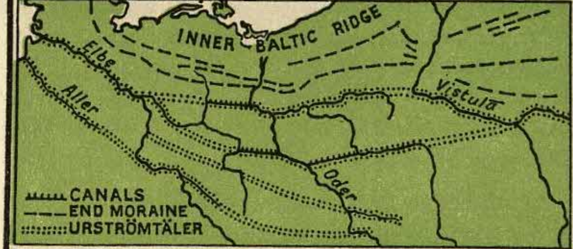
PLAN OF TRIBUTARY GLACIER JOINING MAIN GLACIER SHOWING MORAINES WHICH HAVE FALLEN FROM VALLEY SIDES AND DROPPED AT SNOUT OF GLACIER AS END MORAINE

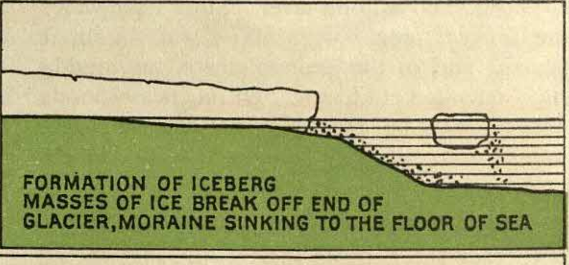
STAGES IN FORMATION OF ROCHE MOUTONNÉE



A IS HUMMOCK BEFORE GLACIATION

B IS SAME HUMMOCK SCRAPED BY GLACIER

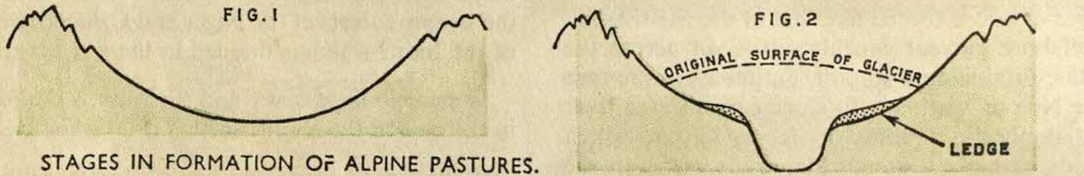




FORMATION OF ICEBERG
MASSES OF ICE BREAK OFF END OF GLACIER, MORAINE SINKING TO THE FLOOR OF SEA

FIG. 1

FIG. 2



STAGES IN FORMATION OF ALPINE PASTURES.

FIG I SHOWS VALLEY BEFORE ICE EROSION. FIG 2 SHOWS VALLEY AFTER GLACIAL ACTION. MOUNTAIN PEAKS HAVE IRREGULAR OUTLINE, SINCE NOT COVERED BY GLACIER. A TROUGH HAS BEEN FORMED WHERE ICE WAS THICKEST. LEDGES (BENCHES, SHOULDERS, REPLATS) LEFT ON FLANKS ARE COVERED WITH DÉBRIS WHICH PROVIDE THE SUMMER PASTURES KNOWN IN SWITZERLAND AS ALPS.

# The Work of Ice

**TYPES OF ICE MASSES.** Sheets of ice of continental dimension are known as **ice sheets,** as instanced by those of Antarctica and Greenland. During the Ice Age, a vast ice sheet, with its centre over Scandinavia, advanced and retreated on several occasions over northern Europe. Another, with centres east and west of Hudson Bay, spread outwards, and in the west coalesced with another sheet located over the Western Cordillera (p. 16). Smaller sheets, like those to be found in Iceland and Norway, are known as **ice caps. Valley glaciers** originate in the snowfields of mountain areas. **Piedmont glaciers** are formed by the coalescence of valley glaciers on to a foreland, e.g. the Malaspina and Bering glaciers of Alaska.

**GLACIAL EROSION.** Glacial erosion is effected (*a*) by **plucking**, i.e. the freezing of rock into the base of the ice and its tearing off by the movement of the ice, and (*b*) by **abrasion**, i.e. the scraping of the rocky floor by rocks embedded in the ice.

**LAND FORMS CAUSED BY GLACIAL EROSION.** **Ice sheets** scrape the surface to leave barren surfaces like those of the Canadian Shield. Water collects in the countless hollows. Melt water pounded against the ice can also form lakes like those of the Great Lakes of North America or valleys like those of the **urströmtäler** of the North European Plain (p. 16).

**Valley glaciers** are responsible for many forms. **Cirques** or **corries** are armchair-like hollows high in the mountains, probably formed by the progressive enlargment of a small pre-existing hollow by the alternate freezing and thawing of snow, and the removal of the loosened rock by melt water. Such hollows are frequently occupied by lakes. **Arêtes**, the name given to knife-edged ridges, are formed when two corries work back to back, and **pyramidal peaks** when several corries cut backwards into each other.

**Glacial valleys,** characterized by a U-shaped cross-section, a flat floor and steep sides, are formed by the moulding of pre-existing valleys by the erosive power of glacial tongues. Where the floor is unevenly eroded, **rock basins** are formed in which lakes collect. Drowning of the ends of such valleys produces the **fiord**. Valleys formerly occupied by tributary glaciers and left at a higher level than the main valley are known as **hanging** valleys. Where a glacier failed to occupy the whole of the valley, ledges known as **benches** were left on the sides.

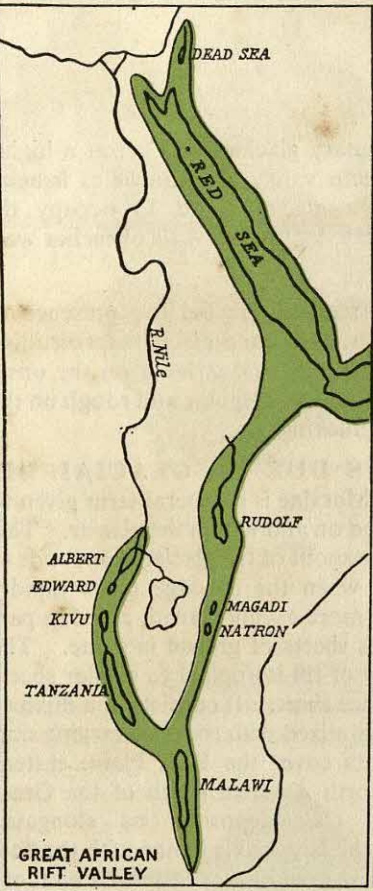
Valley floors frequenty reveal the presence of **roches moutonnées**, the name given to protruding masses of rock polished and striated on the onset side by abrasion and left irregular and rough on the leeward side by plucking.

**LAND FORMS DUE TO GLACIAL DEPOSITION.** **Moraine** is a general term given to rock debris carried on and within the glacier. This is deposited at the snout of the glacier as mounds of **end moraine**, or when the ice-edge melts rapidly and the debris is more evenly spread, aided in part by melt water, as sheets of **ground moraine**. The term **boulder clay** or **till** is applied to similar sheets laid down by an ice sheet. It consists of a mixture of sands and clays mixed with rocks of varying size. Extensive deposits cover the Irish Plain, eastern England, and North America south of the Great Lakes. Boulder clay deposited as elongated hummocks with the larger axis in line with the flow of ice are known as **drumlins**, as instanced by those of the Tweed Valley and the Aire Gap. Laid out **en échelon**, they provide a 'basket of eggs' topography.

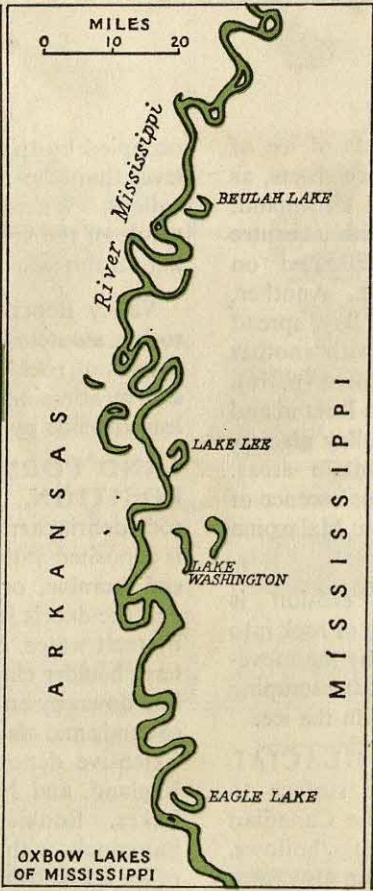
Large blocks of rock carried on the surface of the ice and dropped some distance from the original source are known as **erratics**, e.g. those carried from Shap Fell to the Yorkshire coast. When left precariously balanced they are referred to as **perched blocks**, as in the Pass of Llanberis of North Wales.

**GLACIAL SOILS.** Glacial soils differ in agricultural value. Without them the Irish Plain would be as barren as the karst of Galway. Glacial drift in the valleys and benches of Norway and Switzerland support good pasture. The fertility of North America's Middle West is largely determined by its cover of drift. On the other hand good farming land is scarce on the barren surfaces of the Canadian and Baltic Shields and on the sandy outwash plains of the North European Plain.

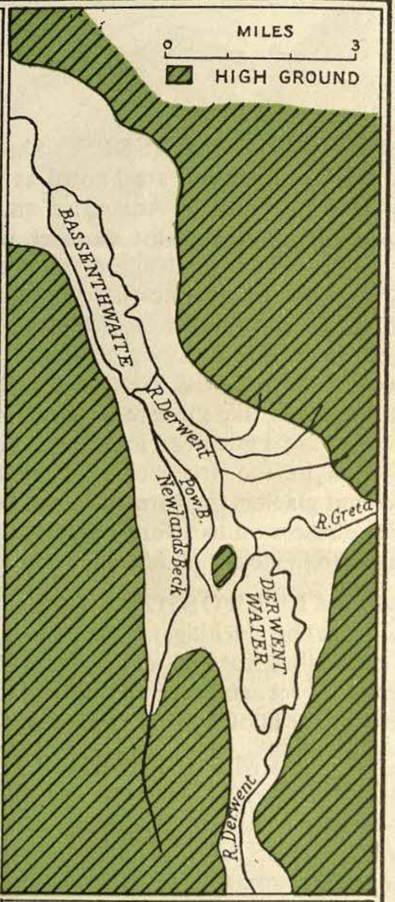
# Lakes

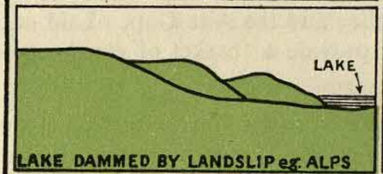


GREAT AFRICAN RIFT VALLEY

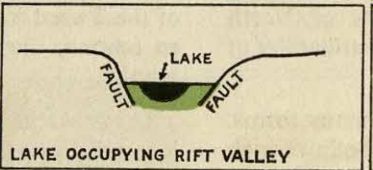


OXBOW LAKES OF MISSISSIPPI

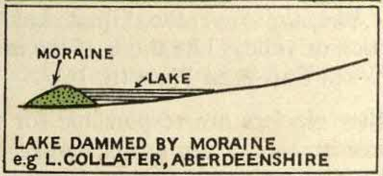




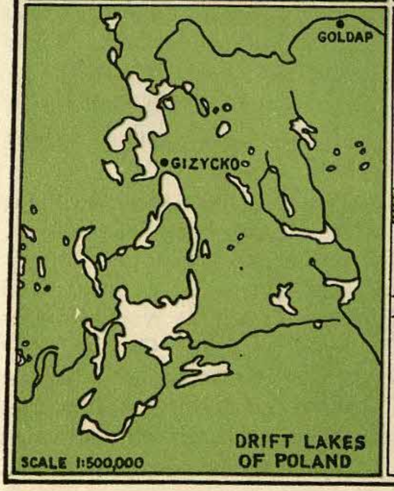
LAKE DAMMED BY LANDSLIP eg. ALPS



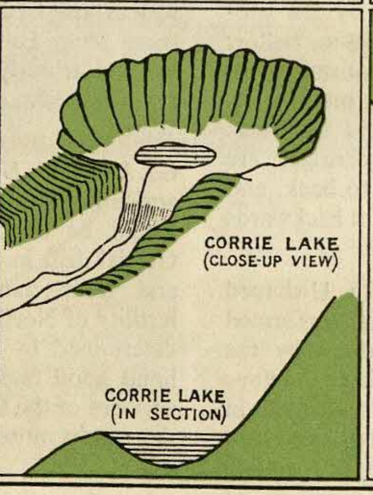
LAKE OCCUPYING RIFT VALLEY



LAKE DAMMED BY MORAINE e.g L. COLLATER, ABERDEENSHIRE

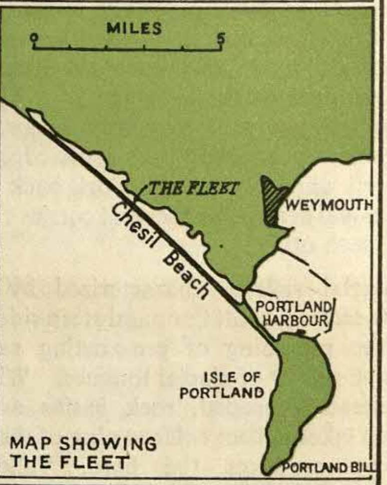


DRIFT LAKES OF POLAND



CORRIE LAKE (CLOSE-UP VIEW)

CORRIE LAKE (IN SECTION)



MAP SHOWING THE FLEET

# Lakes

Lakes are hollows in the earth's crust occupied by water. They can be classified according to their mode of origin, though some owe their origin to more than one cause.

LAKES FORMED BY EARTH MOVEMENT. This type includes **tectonic lakes**, caused by a sagging of the earth's crust, as instanced by Neagh in Ireland, Vänern and Vättern in Sweden, and Titicaca on the Andean plateau; **rift-valley lakes**, such as those of East Africa; and **crater lakes**, such as the 'maaren' of the Eifel, the Crater Lake of Oregon, and the crater lake of Mount Cosigüina in Nicaragua.

LAKES FORMED BY EROSION. These can be subdivided into those caused by glacial erosion, by solution, and by wind. **Glacial eroded lakes** include those occupying (*a*) irregular hollows left after the passage of an ice sheet, as in the Western Isles of Scotland, the Lake Plateau of Finland, and the Canadian Shield, (*b*) corrie lakes occupying armchair hollows high up in the mountains, as in the Lake District, the Scottish Highlands, and Snowdonia, and (*c*) rock-basin lakes formed by the gouging action of valley glaciers, as instanced by Wast Water in the Lake District, Coruisk in Skye, and Dulyn in North Wales. **Solution lakes**, formed by the solution of Carboniferous limestone, include Allen, Ree, and Derg of the Shannon Valley. **Wind-formed hollows**, left after the removal of loose rock, include the Chott Djerid of the Algerian–Tunisian border and the salt lakes of Egypt's Qattara Depression.

LAKES FORMED BY DEPOSITION. These are also known as barrier lakes. **Moraine-dammed lakes** occur in glaciated mountain country, as instanced by Lake Collater in Aberdeenshire, though most finger lakes owe their origin to both overdeepening and the deposition of moraine. **Kettle-hole lakes** occur where an ice block was buried in drift, as in the Vale of Pickering and in the area to the north-east of Carlisle. **Ice-dammed lakes** are those ponded back by ice, as instanced by the Märjelen See of the Oberland by the Aletsch Glacier, and those of Iceland held back by the Vatnajökull ice sheet. **Lava flows** account for the presence of Lake Tiberias in Israel, Lac d'Aydat in the Auvergne, and Lake Kivu in the African Rift Valley. **Oxbow lakes** are formed when a river in spate cuts across one of its meander loops and leaves its abandoned channel silted off as a lake, as in the Trent and Mississippi Valleys. **Deltaic lakes,** such as those of the Rhône and Nile, are the work of an offshore current in building sandspits. The southern Baltic coast provides an example of the action of wind and wave in the isolation of **lagoons** from the sea. An English example is provided by the Fleet, shut off from the sea by the pebbles of Chesil Beach.

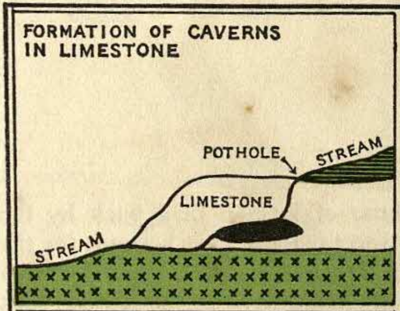
TRANSIENT NATURE OF LAKES. Lakes in hot countries tend to dry up, e.g. Chad in the Sahara, Eyre in Australia, and the Great Salt Lake of the United States. Landslips break away, oxbows are no longer fed by rivers, water seeps through morainic barriers, silt carried into lakes infills them. Lakes Winnipeg and Winnipegosis are remnants of a former Lake Agassiz, the Great Salt Lake of a former Lake Bonneville.

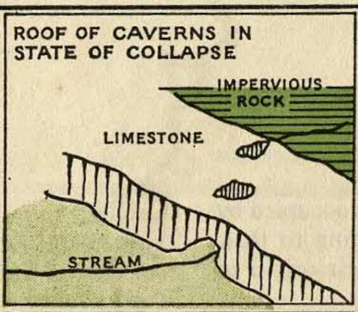
VALUE OF LAKES TO MAN. Some are used as arteries of commerce, e.g. the Great Lakes of North America. Lakes in mountainous terrain can be used for the provision of electrical power (p. 73); some provide drinking water, e.g. Loch Katrine to Glasgow and Thirlmere to Manchester; some which occur in a river-course are valuable in lessening the danger of flood, as instanced by those of the Yangtze Kiang.

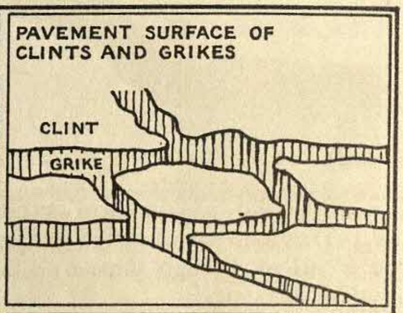
Fruit-farming is possible on the shores of Lakes Ontario and Erie because large water masses modify the temperatures of adjacent land areas. Some lakes abound in fish, e.g. the lakes of the Canadian Shield are a sportsman's paradise.

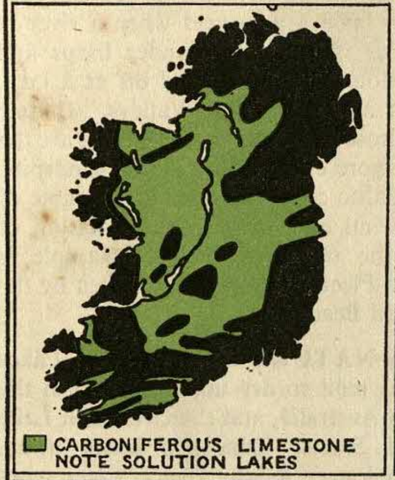
Some old lake-beds provide fertile soil, like those of Lake Agassiz; others provide mineral deposits, such as the borax of the Mojave Desert, the potash of the Dead Sea, and the gypsum of Cheshire.

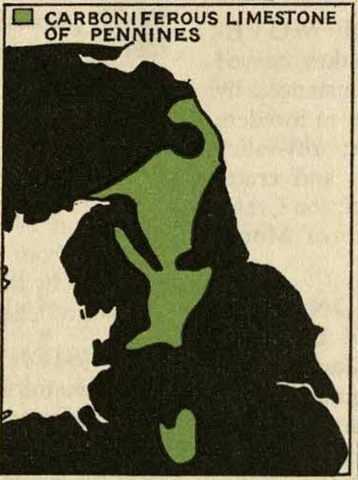
# Granite and Carboniferous Limestone Topography

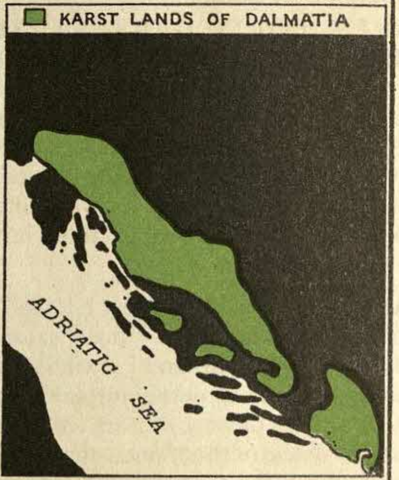


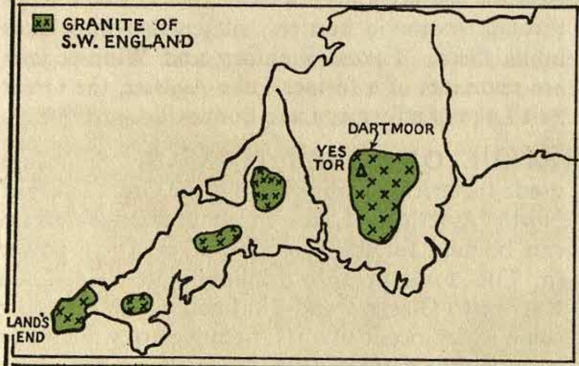


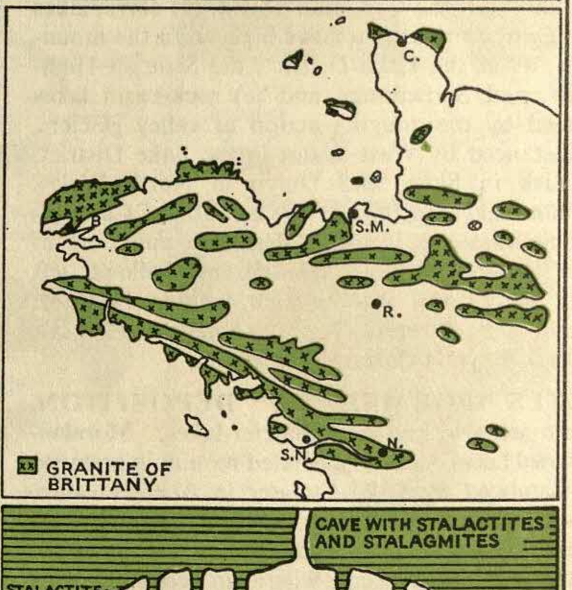


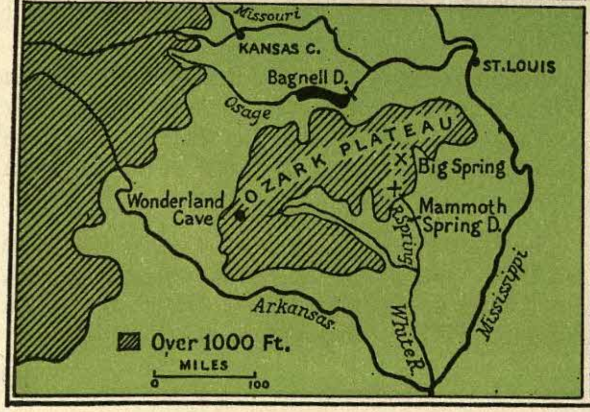


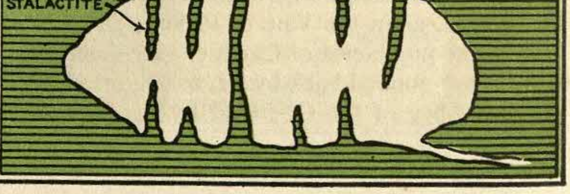












# Granite and Carboniferous Limestone Topography

**Granite** outcrops in temperate latitudes are characterized by rounded hills, sloping gently to wide valleys, occupied by marsh or strewn with boulders. Although a massive rock, granite is seamed with joints into which water seeps. The felspar is slowly decomposed by carbonic acid into silica and hydrated silicate of alumina, that is, into sand and clay. So long, therefore, as felspar is cemented to quartz, granite remains resistant, but each passing shower helps in its disintegration. This explains why some boulders lie embedded in a mass of sand; why some remain isolated, the sand having been removed by running water; why valley floors have their irregularities filled in by sand and clay; and why drainage is bad. One stream looks much like the next, since there is little material with which to corrade its bed.

On **Dartmoor** the large boulders are known as tors and give their name to the hills, e.g. Yes Tor. In spite of the heavy rainfall the ground is thirsty because of the numerous fissures in the granite, but as the water-table is never far from the surface there are numerous springs. Bleakness precludes tree-growth except on the margins. The poor pasture supports hardy strains of sheep and cattle, but farms are few and widely separated.

Where disintegration has produced a white clay it is mined for export to north Staffordshire for use in the china and porcelain industries. Metalliferous ores are associated with granite intrusions. In the early days of the Cornish industry tin was obtained from the gravel of the streams, but nowadays it is all worked from veins.

The granite of **Brittany** presents similar features, but it takes the form of east–west ridges separated by valleys of slate. Consequently, while the uplands are dry-baked wastes covered with poor grass, the lower slopes are clothed with woodlands of oak and beech. While less barren than Dartmoor, the general poverty of the countryside is reflected in the scattered character of the farms and absence of large towns. Nevertheless the small cattle are good milkers and the more favoured localities produce excellent butter. Buckwheat, always indicative of poor soil, is being largely replaced by forage crops. Where the granite reaches the sea it produces the fine headlands or rugged islets reminiscent of Devon and Cornwall, and has given to the Breton the dual life of fisherman–farmer.

**Carboniferous limestone** is soluble in rain-water. In passing over its surface a series of runnels are formed. Water widens the joints and produces the pavement effect typical of the Whernside district of the Pennines, the name 'grikes' being given to the widened joints and 'clints' to the isolated blocks. All soil-cover is washed into the grikes and the bare limestone exposed. Concentration of water at one particular point produces 'swallow-holes', down which water finds its way to great depths and, running along the bedding-planes, dissolves more limestone to form caves. Such caves are ornamented with tapering masses of limestone extending from the roof (stalactites) and others standing upright from the floor (stalagmites), features caused by the evaporation of the carbonate-charged water as it drips from the roof. Streams pass from cave to cave to join a surface stream or appear as springs on a valley side. Occasionally several widened swallow-holes coalesce to form a hole in the roof of a cavern and so produce trough-like depressions such as Cheddar Gorge, the poljes of Dalmatia and the depressions occupied by Florida's lakes. Where the water-table lies but a little distance from the surface few caves appear, as in the Irish Plain, but solution lakes are common, e.g. Allen, Ree, Derg. The Ozark Uplift lying athwart the states of Arkansas and Missouri is a limestone region honeycombed with caves, one of which boasts a thriving night-club! Big and Mammoth Springs emerge from the rocks as full-grown rivers, and the latter has been dammed to furnish electric power.

Mountain limestone regions are sparsely peopled because absence of soil-cover means poor pasture and the fretted surface makes communication difficult. This is particularly true of the Pennines and the Mendips, though it is worth recalling that the sheep of these contributed to the establishment of a woollen industry.

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# Erosion by Wind and Water

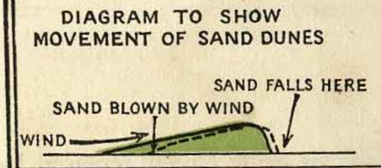


DIAGRAM TO SHOW MOVEMENT OF SAND DUNES

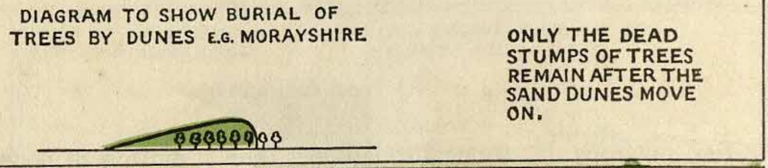
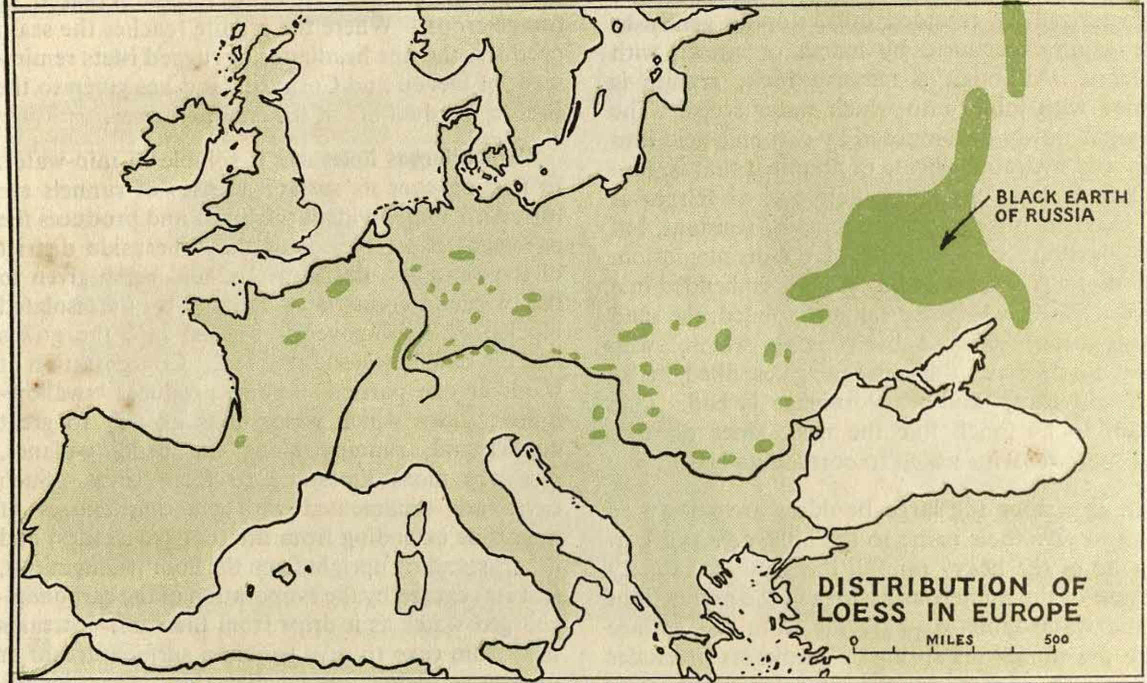
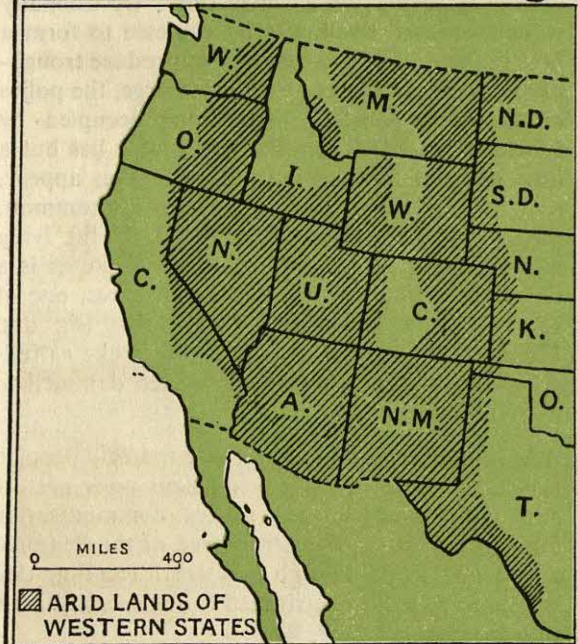


DIAGRAM TO SHOW BURIAL OF TREES BY DUNES E.G. MORAYSHIRE

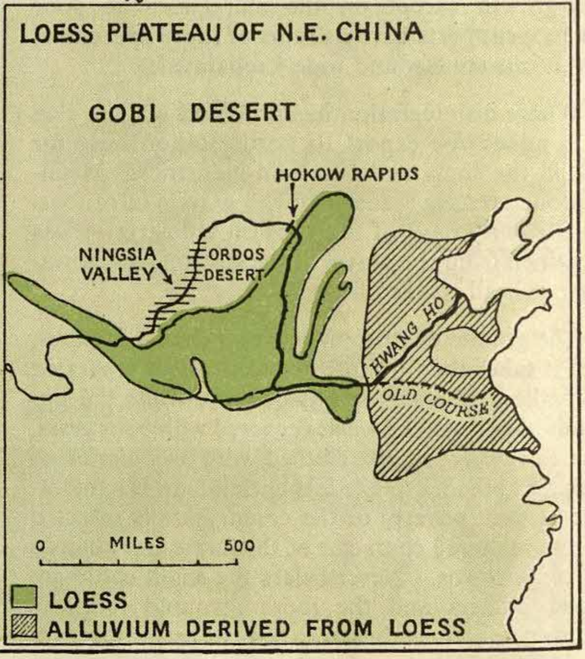
ONLY THE DEAD STUMPS OF TREES REMAIN AFTER THE SAND DUNES MOVE ON.



DISTRIBUTION OF LOESS IN EUROPE



▨ ARID LANDS OF WESTERN STATES



LOESS PLATEAU OF N.E. CHINA

🟩 LOESS

▨ ALLUVIUM DERIVED FROM LOESS

# Erosion by Wind and Water

**WIND EROSION.** Wind erosion is occasioned by the combined effects of deflation, abrasion and attrition.

**Deflation** is the removal of unconsolidated material to form hollows, as instanced by Egypt's Qattara and the depression occupied by Tunisia's Chott Djerid. Man unwittingly assists this process when he ploughs dry land surfaces and then abandons them with no vegetative cover, as evidenced by the Dust Bowl and other areas of the western United States.

**Abrasion** is the sand-blasting of rock surfaces. The shapes produced are related to the nature of the rocks, the alignment of the beds, and the degree of jointing. Abrasion is most effective near the base of projecting rock surfaces. Zeugen is a term given to small tabular masses undercut at the base where less resistant beds occur. Inselberge is a general term for larger masses left in the desert where deflation and abrasion have removed the less resistant rocks, after the name of hill masses present in the Kalahari.

**Attrition** is the reduction in size of wind-borne particles by collision with each other and with rock surfaces in their path.

**DEPOSITION BY WIND.** This is to be seen in dunes and loess. Dunes are rarely static. They are moved forward by the rolling up of sand on the windward side and its falling down on the leeward. **Barchans** are crescentic dunes lying transverse to the wind with their horns trailed out in front of them, as in the deserts of Peru and Turkestan. Longitudinal or **seif dunes** are formed when the tips of barchans are halted (e.g. by vegetation) and the central part blown through the wings, or when the wings are blown away by cross-winds, thus allowing the dunes to coalesce in long lines. The dominant wind maintains a corridor between the lines. Most of the dunes of the Sahara and Western Australia are of this type.

**Loess** is wind-borne material which has been carried beyond its source, as instanced by that of north China, blown from the Gobi Desert by outblowing winds of the winter Asiatic high-pressure area and presumably arrested by grassland vegetation. It obliterates the former relief, infilling valleys to depths of from 300 to 1,000 feet. Rivers have cut deep trenches into it; man likewise by treading it down through the centuries.

The loess of Belgium and north-eastern France, known as **limon**, and that adjacent to the uplands of the European Plain, appear to consist of wind-borne material laid down in the dry interglacial and post-glacial periods and later redistributed by water. Loess occupies the valleys of the Carpathians and hollows in the Danubian Plain. The Black Earth of Russia consists of fine soils in which both wind and water may have played a part.

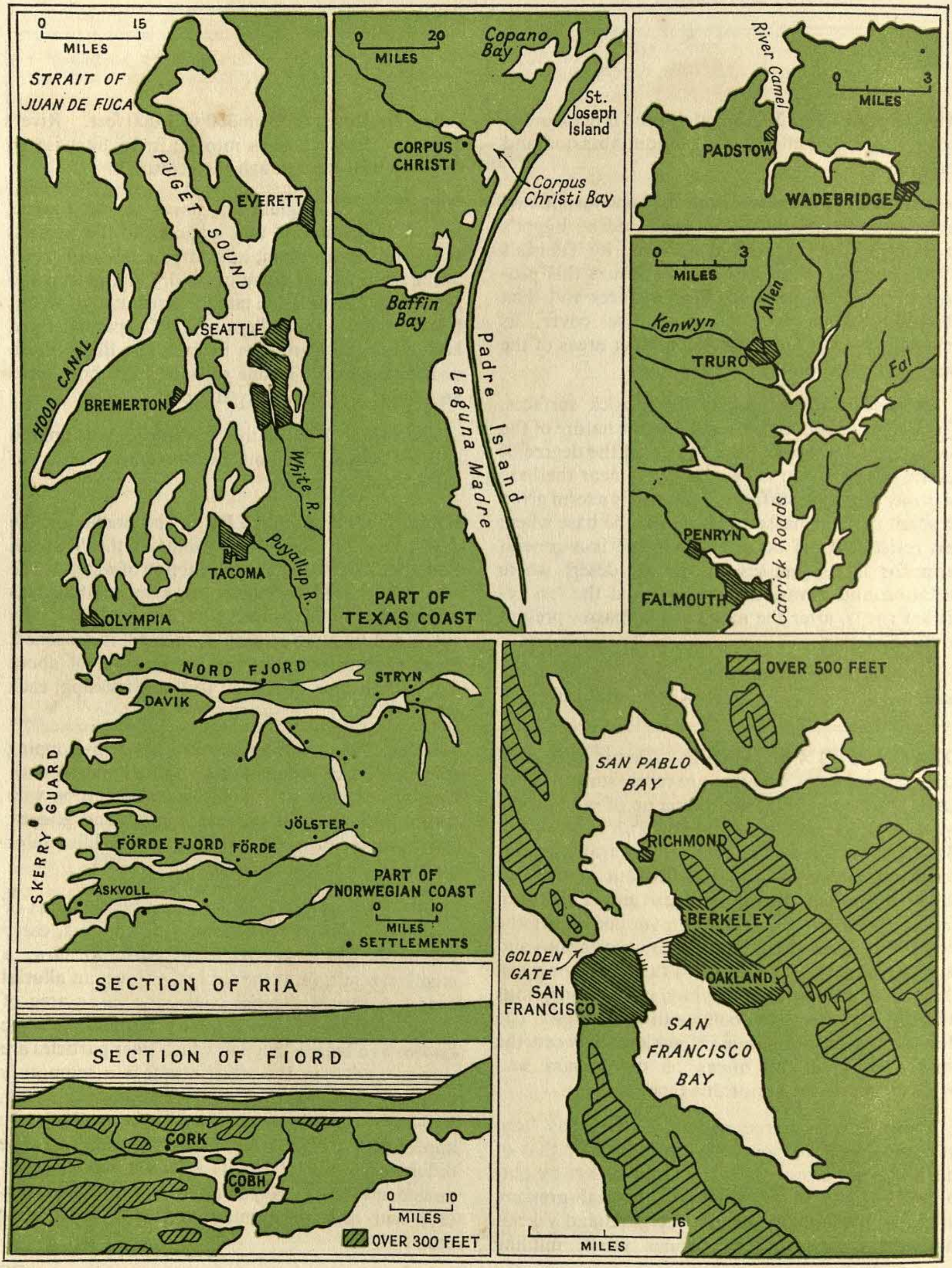
The rolling hills of the Palouse in Washington and the **adobe** of Illinois and Iowa also consist of wind-borne material.

**EROSION BY WATER.** The **wadis** of the desert and the steep-sided gullies of the Missouri Badlands illustrate the erosive action of water. The smooth-surfaced **pediments** are also attributed to water. In humid climates sheet erosion is generally succeeded by gully erosion as each rill is deepened. Sheet erosion accounts for the removal of about 400 million tons of topsoil to the Mississippi each year.

Sheet erosion can be checked by strip-cropping (the planting of different crops along the contours), e.g. by the alternation of clean-tilled crops with soil-protecting crops such as legumes and grasses. Terracing is also used. Gullies can be filled in or planted with creeping vines.

**DEPOSITION BY WATER.** Flash floods of the desert, caused by torrential downpours, carry off loose rock. Where these cease to flow, a **mudflow** is left, or at the foot of a slope, an **alluvial cone.** A series of cones coalescing in an area of inland drainage forms a gently undulating slope known as a **bajada**, beyond which finer particles are carried and then the water itself as a temporary lake, known in the United States as **playa** or **salina,** in Mexico as **bolson**, and in Algeria as **chott**. In appearance a bajada resembles a piedmont. The difference is that a bajada is composed of transported material. A piedmont is a polished outcrop with only the thinnest veneer of transported material.

# Coastlines


0 15
MILES
STRAIT OF JUAN DE FUCA
PUGET SOUND
EVERETT
HOOD CANAL
SEATTLE
BREMERTON
White R.
TACOMA
Puyallup R.
OLYMPIA
0 20
MILES
Copano Bay
St. Joseph Island
CORPUS CHRISTI
Corpus Christi Bay
Baffin Bay
Padre Island
Laguna Madre
PART OF TEXAS COAST
River Camel
0 3
MILES
PADSTOW
WADEBRIDGE
0 3
MILES
Allen
Kenwyn
TRURO
Fal
PENRYN
Carrick Roads
FALMOUTH
NORD FJORD
STRYN
DAVIK
SKERRY GUARD
JÖLSTER
FÖRDE FJORD
FÖRDE
ASKVOLL
PART OF NORWEGIAN COAST
0 10
MILES
• SETTLEMENTS
SECTION OF RIA
SECTION OF FIORD
CORK
COBH
0 10
MILES
OVER 300 FEET
OVER 500 FEET
SAN PABLO BAY
RICHMOND
BERKELEY
GOLDEN GATE
SAN FRANCISCO
OAKLAND
SAN FRANCISCO BAY
16
MILES

Coastlines can be classified as emerged or submerged, though their character depends on the nature of the former coastline, e.g. upland or lowland.

**Emerged Upland Coasts** are characterized by a raised beach or cliff-line. The old coastline, some distance above sea-level, can be recognized by its wave-cut platform of rock mantled by ancient beach material and a cliff face frequently notched with caves. Three distinct levels occur in western Scotland, one at about 100 feet, another at 50 feet, and another at 25 feet.

**Emerged Lowland Coasts** have been formed by the emergence of the continental shelf. Consequently, they merge into the coastal plain without any change of slope, as exemplified by those of south-eastern United States, the Texas coast and the southern shore of the Plate estuary in Argentina. They consist of sandstones, shales, and limestones recently consolidated from sands, gravels and calcareous material.

**Submerged Upland Coasts** are of three types — ria, fiord and Dalmatian.

The **ria coast** has been formed by the drowning of the valleys of an upland coast in which the hills and valleys meet the sea more or less at right angles. Rias have abrupt slopes and decrease in depth and width as they extend inland. Streams which enter the head of the ria are tiny relics of much bigger rivers, and when the tide is out, appear as mere trickles in a maze of mud. Examples are provided by north-west Spain, Brittany, south-west England, and south-west Ireland.

The **fiord coast** has been formed by the submergence of glaciated valleys, and like the original valley, the fiord has a U-shaped cross-section, hanging valleys, truncated spurs, and an uneven floor. A bar or threshold of solid rock frequently occurs near the entrance of the fiord, and areas of high ground cut off from the mainland appear as offshore islands. In regions of high relief, fiords are steep-sided, as in Norway, Iceland, Greenland, western Scotland, north-western Ireland, the panhandle of Alaska, southern Chile, and the south-west of New Zealand's South Island. In Sweden and Finland a more subdued relief gives fiords with more gently-sloping sides.

The **Dalmatian type of coast** has been formed by the drowning of an upland coast where mountain ranges run parallel with the coast. The coast is more regular than that of the ria or fiord except where the submergence of cols in the outer ranges have allowed the penetration of the sea into interior valleys. Examples are provided by the Dalmatian coast of Yugoslavia, by the southern coast of Ireland as in the case of Cork and Youghal harbours, and by San Francisco Bay in California. Such a coast is also to be seen in southern Chile and British Columbia–Washington, where the outer mountain range is left as a series of islands. These last two coasts, therefore, portray features of both fiord and Dalmatian types.

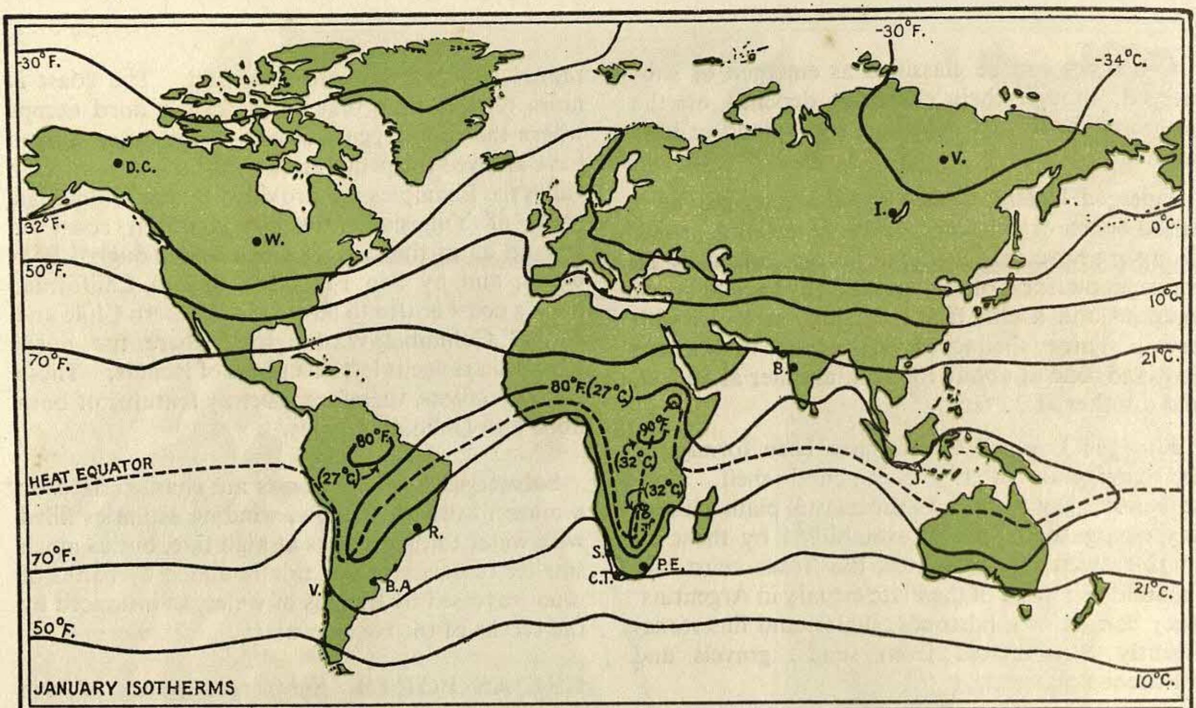
**Submerged Lowland Coasts** are characterized by a maze of broad, shallow, winding estuaries filled with water to their banks at high tide, but as much smaller estuaries at low tide bounded by banks of mud traversed by trickles of water, as instanced by the creeks of the Essex coast.

**USE AS PORTS.** Submerged coasts provide deep water and shelter from storm, though other factors are necessary in their usefulness as harbours, such as the nature of the hinterland, distance from consuming centres, and location with regard to world trade routes.

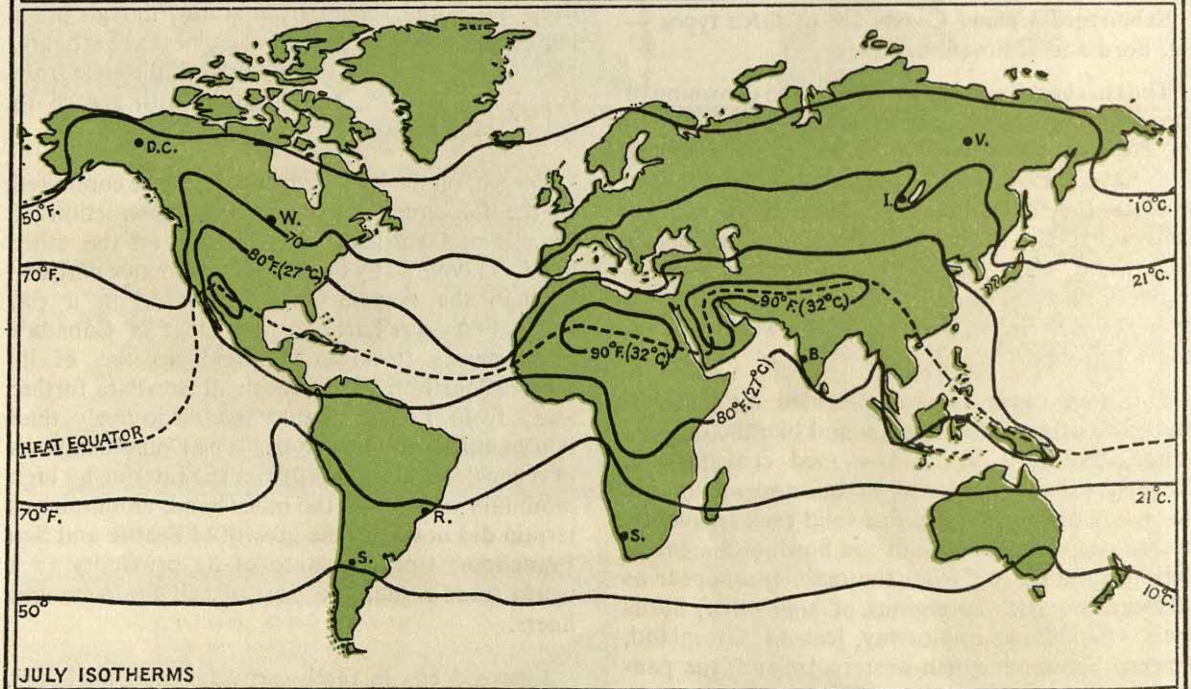
Bergen, on the By Fjord, could only be connected to the Glommen Valley by the construction of tunnels and cuttings. New York, on the other hand, is favoured by the Hudson–Mohawk corridor through the Appalachians. Halifax, on a ria, has a first-class harbour, but most of Canada's trade passes through Montreal because of its interior location. Falmouth and Brest are further away from London and Paris respectively than Southampton and Le Havre. The Dalmatian ports of Yugoslavia are cut off from the interior by high mountain walls. On the other hand, mountainous terrain did not deter the growth of Seattle and San Francisco. Cork, because of its proximity to a world trade route, is a port of call for American liners.

Emerged coasts rarely provide good harbours. Necessity, however, may demand their use. Charleston and Savannah owe their existence not to the excellence of their harbours but as outlets for the towns of the Appalachian Piedmont. Buenos Aires, one of the world's major ports, is largely artificial.

# Temperature



JANUARY ISOTHERMS



JULY ISOTHERMS

POLAR TEMPERATURES (Jan. to Dec.)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VERKHOYANSK | °F. | -59 | -47 | -24 | 7 | 35 | 54 | 59 | 50 | 36 | 5 | -34 | -52 |
| | °C. | -51 | -44 | -31 | 14 | 2 | 12 | 15 | 10 | 2 | -15 | -37 | -47 |
| DAWSON CITY | °F. | -24 | -14 | 3 | 28 | 48 | 57 | 60 | 55 | 42 | 27 | -1 | -10 |
| | °C. | -31 | -26 | -16 | -2 | 9 | 14 | 16 | 13 | 6 | -3 | -18 | -23 |

# Temperature

An **isotherm** is a line passing through all places having the same temperature, allowance being made for altitude. Thus a place 3,000 feet high with a mean monthly temperature of 60° F. (16° C.) is shown on the map with a temperature of 70° F. (21° C.), because temperature decreases by 1° F. for about every 300 feet ascent or 1° C. for about 540 feet.

**MEAN TEMPERATURES.** A maximum and minimum thermometer records the highest and lowest temperatures for the day, and the mean is obtained by adding these together and dividing by two. The mean monthly temperature is obtained by adding the means for each day and dividing by the number of days.

**UNEQUAL HEATING OF LAND AND SEA.** If the globe was all of the same composition and all surfaces at the same altitude, temperatures would decrease regularly from the tropics to the poles (p. 7). This is not borne out by isotherms. The main reason is that land surfaces heat more quickly than sea because (*a*) the heat capacity of water is greater than that of soil so that about four times as much heat is required to raise an ounce of water to the same temperature as an ounce of soil, (*b*) the sun's rays penetrate more deeply into water and thus have to heat a greater volume of water than soil, (*c*) much heat is reflected from water surfaces and much employed in evaporating it and not in raising its temperature, (*d*) the sea is in constant motion and considerable quantities of heat are carried away by convection currents. The net result is that land surfaces heat up more quickly than sea in summer and cool more quickly in winter. Coastal areas therefore show a lower annual range of temperature — the difference between the hottest and coldest months — than continental areas in the same latitude, e.g. Edinburgh 21° F. (12° C.), Moscow 53° F. (29° C.).

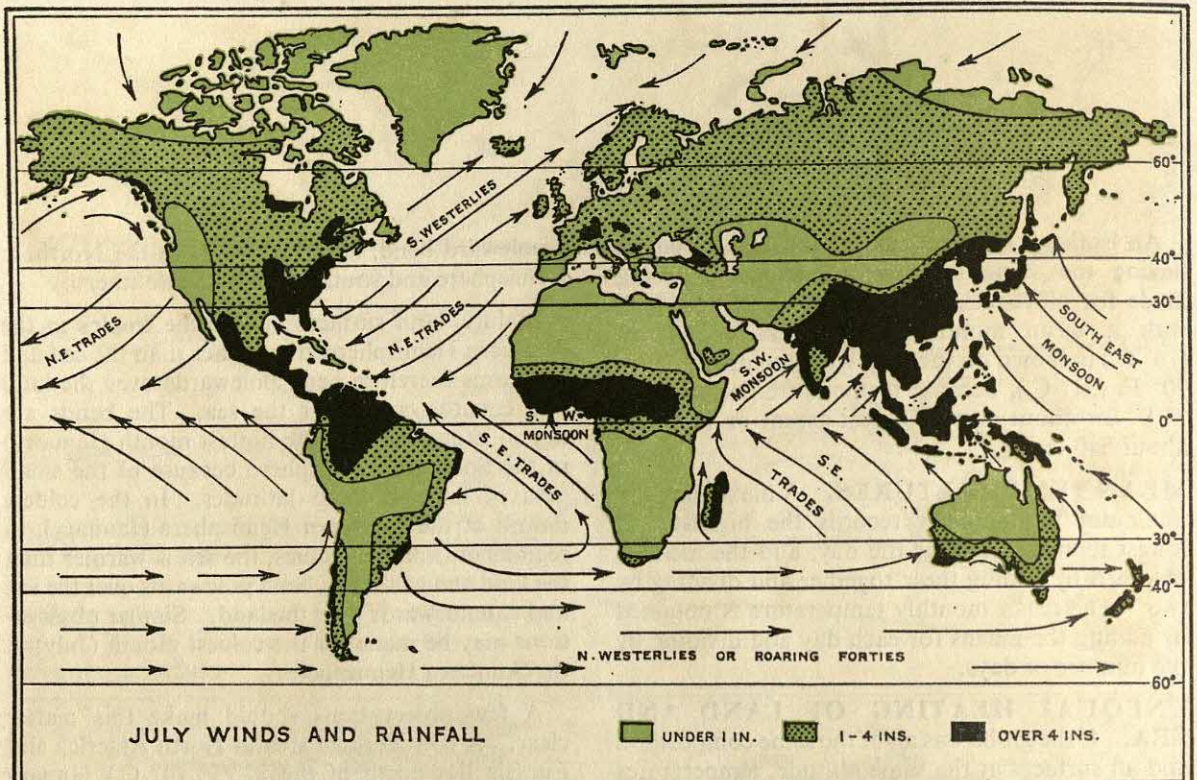
In the **tropics**, the regions of greatest heat will lie north of the Equator in July and south of it in January because of the position of the sun (p. 7), but as tropical regions are always hot, land surfaces are always warmer than the sea and isotherms show a poleward bend, i.e. northwards in the Northern Hemisphere and southwards in the Southern.

In July, land surfaces **outside the tropics** in the Northern Hemisphere are warmer than the sea and isotherms therefore bend polewards over the land and equatorwards over the sea. The bends are not so pronounced in the hottest month (January) in the Southern Hemisphere because of the small area of land in these latitudes. In the coldest month of the Northern Hemisphere (January), in regions outside the tropics, the sea is warmer than the land and isotherms bend polewards over the sea and equatorwards over the land. Similar observations may be made for the coldest month (July) in the Southern Hemisphere.

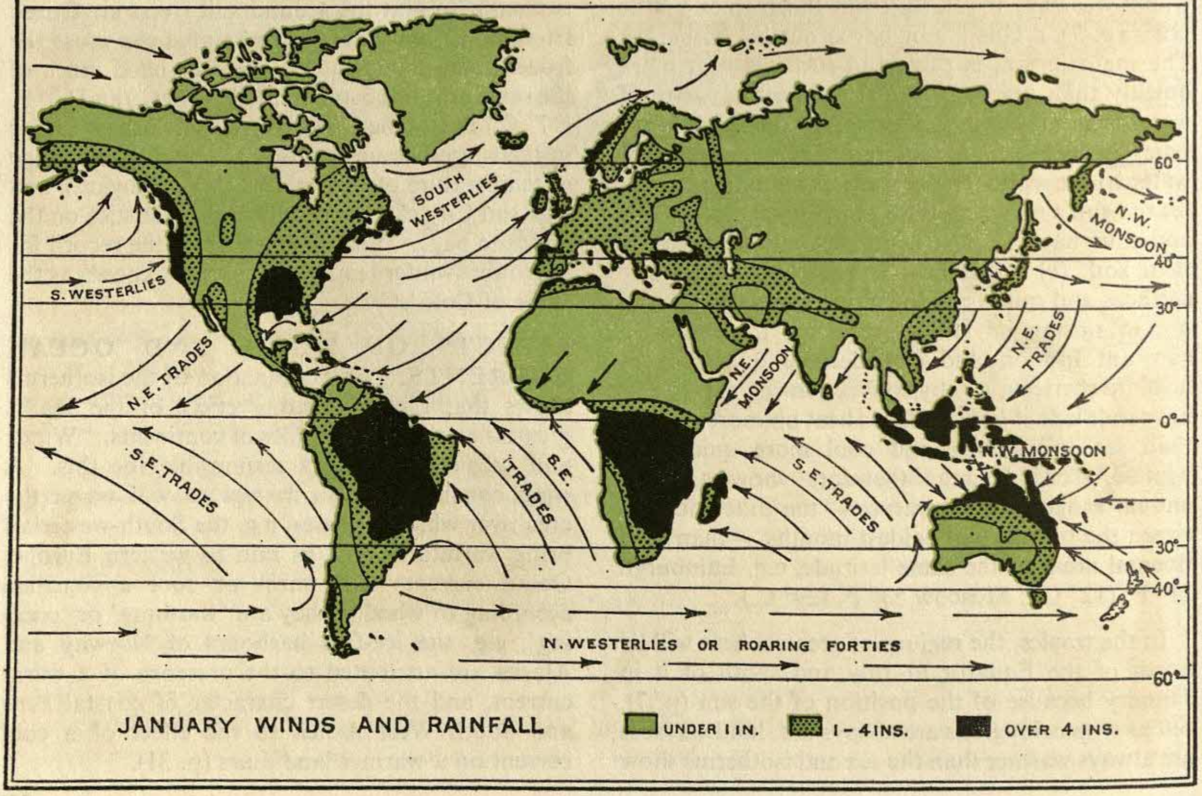
A few observations should make this matter clear. A considerable area in North America and Eurasia lies north of the 32° F. (0° C.) January isotherm, so that the ground and rivers are frozen from six to nine months and traffic can cross the frozen Lake Baikal. On the other hand much of the same area lies between 50° F. (10° C.) and 80° F. (27° C.) in summer, and rivers, which thaw earlier in their upper courses, flood the land. The range of temperature of such places as Verkhoyansk and Dawson City can be seen from the statistics on the opposite page. Verkhoyansk holds the record for the lowest winter temperatures and is known as the 'Pole of Cold'.

**EFFECTS OF WINDS AND OCEAN CURRENTS.** An examination of the isotherms shows that the moderating effect of the sea is greatest on the western sides of continents. Winds and ocean currents are responsible for this. A wind coming from warm regions will warm the area over which it passes, e.g. the South-westerlies bring warmth as well as rain to western Europe. Ocean currents will warm or cool a coastline according to whether they are 'warming' or 'cooling', e.g. the ice-free harbours of Norway and Alaska are attributed to the presence of a warm current, and the desert character of coastal Peru and South West Africa to the effect of a cool current on a warmer land mass (p. 31).

# Winds and Rainfall



JULY WINDS AND RAINFALL



JANUARY WINDS AND RAINFALL

# Winds and Rainfall

**PRESSURE BELTS.** Wind is the movement of air from high to low atmospheric pressure, and because of the earth's rotation is deflected to the right in the Northern Hemisphere and to the left in the Southern. Three major pressure systems can be identified: (*a*) the **equatorial low** of equatorial latitudes, (*b*) the **subtropic high** between 25° and 35° N. and S. latitude, sometimes known as the horse latitudes, and (*c*) the **subpolar low** between 60° and 70° N. and S. latitude.

If the earth were all of the same composition these pressure belts would girdle the earth. Since, however, land heats up more quickly and cools more quickly than water, the pressure systems appear as 'cells'.

**PLANETARY WINDS.** Winds are drawn into the equatorial low from the subtropic highs, and because of the earth's rotation, appear as **North-east trades** in the Northern Hemisphere and as **South-east trades** in the Southern.

Winds moving from subtropic highs to subpolar lows are known as **South-westerlies** in the Northern Hemisphere and as **North-westerlies** in the Southern. Land masses disrupt the course of the South-westerlies. The North-westerlies are stronger and more persistent because of the absence of any large land surface, and are also known as the 'roaring forties'.

The Westerlies of both hemispheres meet the **Polar Easterlies** at the subpolar lows or polar fronts, and because of the great differences in their temperatures, give rise to cyclonic storms.

These wind belts migrate with that of the overhead sun. On June 21 the sun is overhead at the Tropic of Cancer, so that the wind systems shift a few degrees northwards in the Northern Hemisphere summer. On December 21 the sun is overhead at the Tropic of Capricorn, and the wind systems shift southwards.

**LATITUDES 0° TO 30°.** Ascending air in the equatorial lows is cooled adiabatically and its water vapour condensed. Rain falls throughout the year. Trade winds in passing over the ocean bring rain to the eastern sides of continents, and more especially where they are forced upwards by high relief, as in western Malagasy. The leeward side is drier.

**LATITUDES 40° TO 60°.** Westerly winds blow throughout the year, so that western sides of continents have a well-distributed rainfall. Where relief causes heavy condensation the leeward sides are drier, as in British Columbia, southern Chile, and the South Island of New Zealand. An irregular distribution of relief in western Europe allows of a more even distribution.

**LATITUDES 30° TO 40°.** Lands in these latitudes experience Trades in summer and Westerlies in winter. Western sides of continents are regions of summer drought and winter rain, viz. the Mediterranean Sea area, California, central Chile, the south-west tip of South Africa, and south-west Australia. The south-east of Australia also enjoys this mediterranean type of climate because of the Westerlies which blow over the Australian Bight.

**MONSOON AREAS.** The irregular distribution of land and sea superimposes auxiliary winds upon the planetary circulation in some areas. In winter, winds blow out from the cold heart of Asia to the warmer sea, as a north-west monsoon over Korea and Japan and as a north-east monsoon over India. They are dry except where they pass over the sea. They bring rain to western Japan, coastal China, Indonesia, south-east India, and Ceylon.

In summer a low-pressure system develops over central Asia and another over the Punjab. Winds move onshore. The North-west Monsoon is reinforced by the South-east Trades and brings heavy rain to India, Burma, and south-east Asia, and as the South-east Monsoon, to China and Japan.

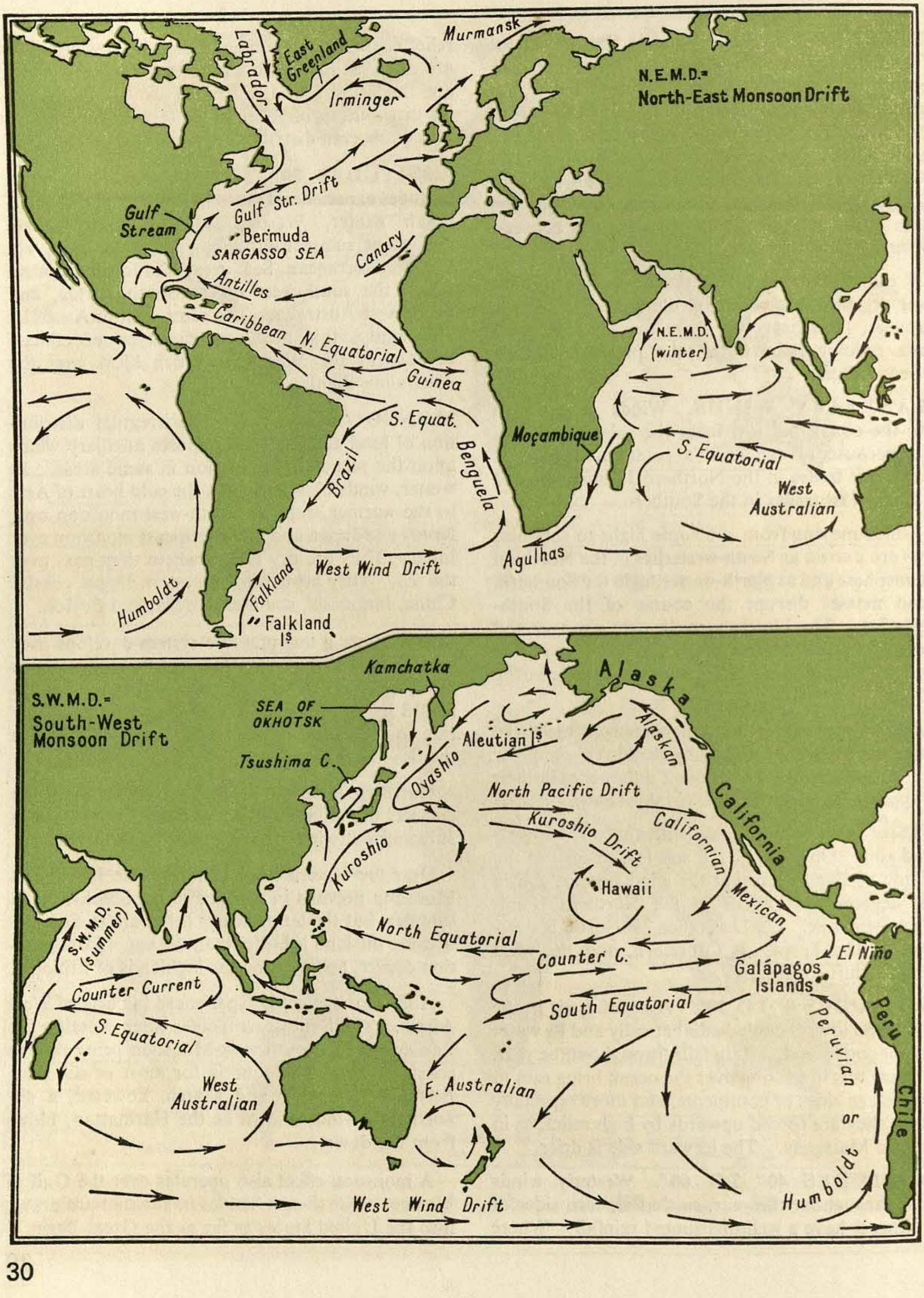
Northern Australia also experiences a monsoon climate, dry winds moving outwards to the sea in July and wet winds moving inwards in December.

Over the eastern horn of Africa the North-east Monsoon prevails in winter and the South-west in summer, but the latter brings little rain to Somalia because the land is hotter than the sea. Condensation occurs, however, on the highlands of Ethiopia.

A monsoon effect is experienced in parts of West Africa. The South-east Trades after crossing the Equator as the South-west Monsoon bring rain to coastal Guinea and Liberia for most of the year. Between November and March, however, a dry north-east wind, known as the Harmattan, blows from the desert.

A monsoon effect also operates over the Gulf of Mexico. North-east Trades in summer are drawn into the United States as far as the Great Basin.

# Ocean Currents



# Ocean Currents

Differences in density caused by salinity determine the direction of **cold currents** from Arctic and Antarctic waters. Otherwise the principal factor is the prevailing winds. **Warm currents** move polewards, **cool currents** equatorwards.

**ATLANTIC AND PACIFIC CIRCULATIONS.** Trade Winds push surface water eastwards, and while some is returned by countercurrents, the rest is diverted northwards and southwards by the continents. In the Atlantic the northward flow emerges from the Florida Strait as the **Florida Current** or **Gulf Stream.** Off Cape Hatteras it fans out into the Atlantic and is carried north-eastwards under the influence of the South-westerlies into Arctic waters. The corresponding **Kuroshio** is carried eastwards as a well-defined stream until it begins to gyrate southwards. In both oceans, streams reach the western sides of the continents. The **Canary Current** and **Californian Current** return water to the equatorial currents. The **Alaskan Current** completes the circulation in the northern Pacific.

Circulation in the South Atlantic is maintained by the **Brazil Current**, the **West Wind Drift** and the **Benguela**; in the South Pacific by the **East Australia Current, West Wind Drift** and the **Humboldt.**

Cold currents are those of the **Labrador** from the Davis Strait, the **Oyashio** from the Sea of Okhotsk, and the **Falkland** and other drifts from the Antarctic.

**INDIAN OCEAN CIRCULATIONS.** If further proof of the cause of ocean currents is needed it is to be found in the North Indian Ocean where currents are reversed by the prevailing winds, the **North-East Monsoon Drift** of winter and the **South-West Monsoon Drift** of summer.

In the South Indian Ocean the equatorial current is turned south by the African coast as the **Moçambique Current** and continued into the Atlantic as the **Agulhas Current**. Circulation westwards is maintained by west wind drifts and off Australia as the **West Australia Current.**

**CLIMATIC EFFECTS.** The North Pacific is closed, but the North Atlantic is wide open and a gulf of warmth is carried into Arctic waters. In winter Labradoran coasts are icebound by the cold air blowing from Canada as well as by the coldness of the Labrador Current.

In similar latitudes of the Pacific the Sea of Okhotsk is frozen over during winter by the cold air blowing from Siberia's pole of cold, but Alaskan harbours are kept icefree by the Alaskan Current.

Icebergs which break off Greenland's glaciers in spring are carried southwards by the Labrador Current, on occasion as far as New England. They maintain the coldness of the water and constitute a danger to shipping. Sea ice from the Sea of Okhotsk is carried southwards by the Oyashio, but there are no icebergs. Glaciers which reach Alaskan fiords are immediately melted by the warmth of Alaskan waters. In the Antarctic, icebergs are carried northwards by the Falkland and other drifts, but they melt long before they reach the Plate and Australian waters.

Currents frequently affect coastal areas when winds are onshore. Thus western coasts are usually cooler than eastern, e.g. Valparaiso has lower temperatures than Buenos Aires because of the Humboldt Current, and Cape Town than Durban because of the Benguela Current.

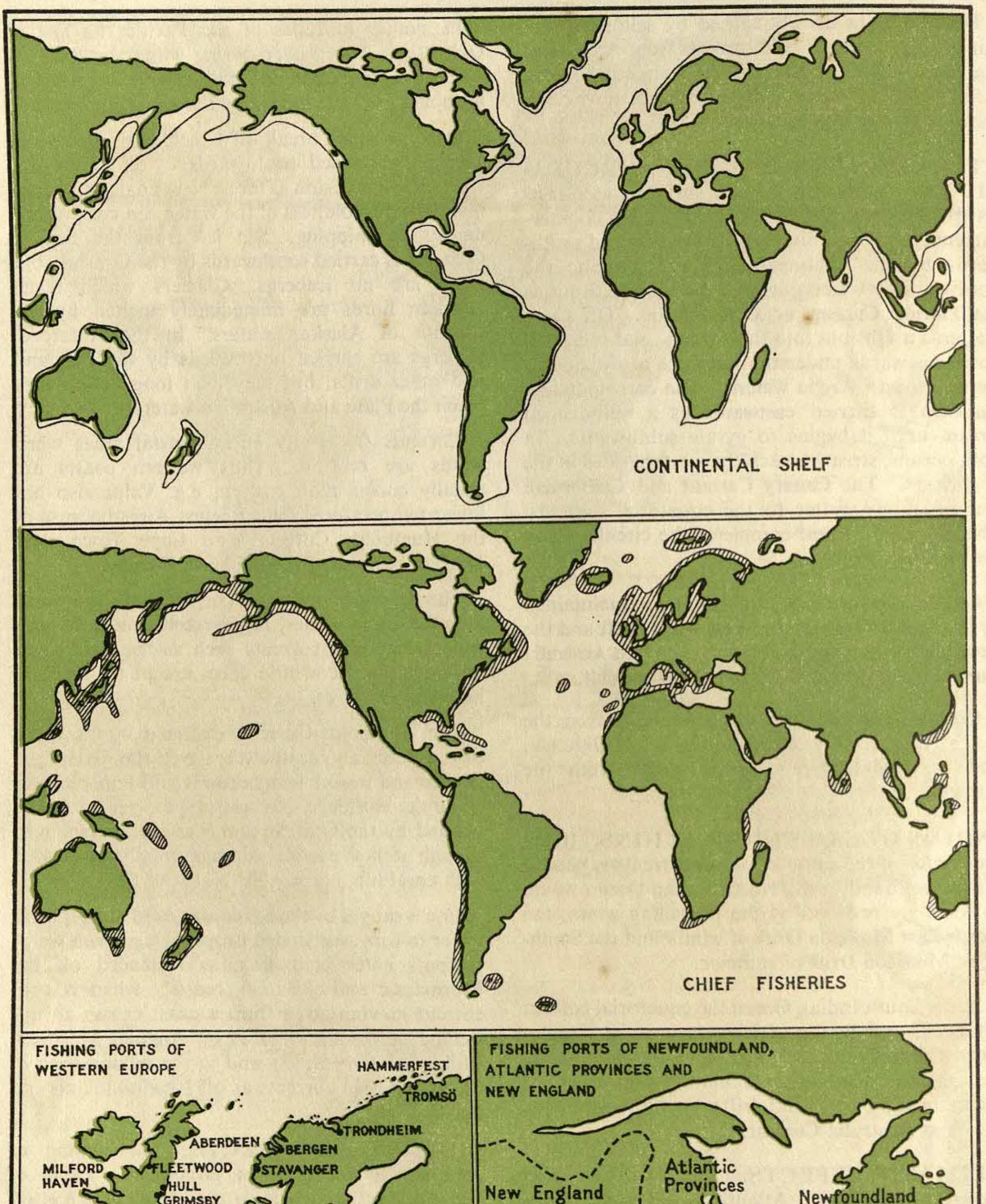
The Kuroshio is a warm current, but since winds are offshore in winter, Japan receives little warmth from it. Warm currents such as the Brazil and Moçambique have little effect except to maintain high temperatures.

The Humboldt Current, deflected by the curve of the Peruvian coast, sweeps past the Galápagos Islands and lowers temperatures sufficiently to preclude the existence of coral polyps, yet Bermuda, washed by the Gulf Stream, has coral reefs, even though it lies outside zones normally associated with coral life, namely 30° N. to 30° S.

Fog is caused by the condensation of atmospheric water to form suspended droplets, e.g. when warm currents enter cold seas, as instanced off the Murmansk and Aleutian coasts; when a cool current moving away from a coast causes an upwelling of colder water as off Angola, Morocco, Chile, and California; and in the mixing-zone of warm and cold currents as off Newfoundland and northern Japan.

**BIOLOGICAL EFFECTS.** The mixing of cold and warm currents promotes a range of temperature favourable to the life of fish, e.g. off Newfoundland, northern Japan, and Cape Town. Upwelling water brings nutrient salts to the surface to the benefit of plankton, e.g. off Peru, California, and Angola (p. 33).

# Fishing Grounds



**PLANKTON.** Plankton is the name given to the masses of microscopic organisms present in the sea, sometimes referred to as sea pastures, which serve as a source of food for fish.

Although the natural laws governing this exuberance of life are not fully understood, it is well known that plankton is prolific in waters of different provenance, namely, on the margins of currents and in zones of contact between warm and cold water, where mixing of the waters provides a great range of temperature at the surface. Storms also ensure the penetration of air and light into surface waters and thereby promote vegetable and microscopic life.

**TYPES OF FISH.** Fish can be divided into two broad classes, pelargic and demersal. The former live in zones not far from the surface and include herring, mackerel and pilchards. The latter live near to or on the bottom of the sea and include round fish such as cod and hake and flat fish such as sole and plaice. Demersal fish, therefore, require the presence of a continental shelf and are usually caught by trawl, much to the detriment of future stocks, since the bottom of the trawl scrapes the sea floor, damaging or destroying worms and crustacea on which young fish feed.

**WESTERN EUROPE.** The continental shelf of western Europe from Portugal to northern Norway, and the shelves around the Faroes, Iceland, Greenland, Spitsbergen and Bear Island, are the fishing grounds of many European nations, though the fleets of Denmark and the Netherlands tend to confine their activities to home waters and those of Spain and Portugal to visit Newfoundland waters rather than those of the Arctic. Outstanding so far as the annual catch of demersal fish is concerned are the United Kingdom, Norway, the U.S.S.R., West Germany, Spain, Iceland, and France, generally in that order.

**JAPAN.** The shelf from Sakhalin to Formosa is a source of fish for neighbouring countries, and especially for Japan, where the industry is highly commercialized. Fish is of immense importance in a land where meat is scarce and where fish products can be used as fertilizer for the ricefields. Japanese fleets travel much further afield, however, e.g. to Australian, South African, and West African coasts. Japan is the world's premier fishing nation, with a catch much higher than that of any other nation.

**ATLANTIC NORTH AMERICA.** The 'banks' off Newfoundland and Nova Scotia are the source of fish for Newfoundland, the Atlantic Provinces of Canada and New England. Half of Newfoundland's catch, however, is derived from the inshore fishery. Boats also visit Labradoran waters, though the quality of the catch is inferior to that of the banks and home waters. Fishing boats from New England also make use of the shelf as far south as Chesapeake Bay.

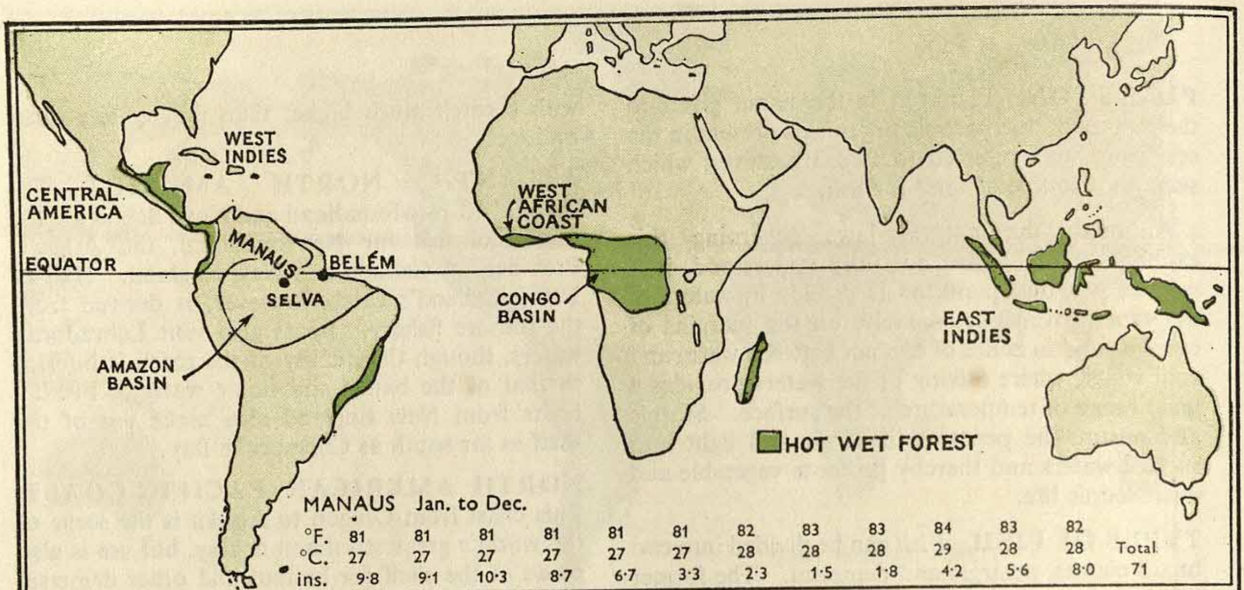
**NORTH AMERICAN PACIFIC COAST.** This coast from Oregon to Alaska is the scene of the world's greatest salmon fishery, but use is also made of the shelf for halibut and other demersal fish. Salmon spawn in the quiet pools of river headstreams. The young fish swim out to sea each year. Within a few years they reach maturity and swim back to spawn. It is then that the fishermen make their catch. The economy of British Columbia is almost as dependent on fish as on lumber.

**THE REPUBLIC OF SOUTH AFRICA.** The Republic of South Africa is the largest fishing nation in the Southern Hemisphere. Trawling is pursued off Cape Agulhas, in the Dassen Island and Saldanha areas, and on the banks off Port Nolloth. The main catch, however, is of pelargic fish — pilchards, massbankers, and mackerel — and shellfish.

**ANGOLA.** Angola to the north also benefits from its export of dried fish, oils, and meals. Offshore winds cause the Benguela Current to be pushed out to sea and the consequent upwelling brings nutrient salts to the surface for the maintenance of plankton populations.

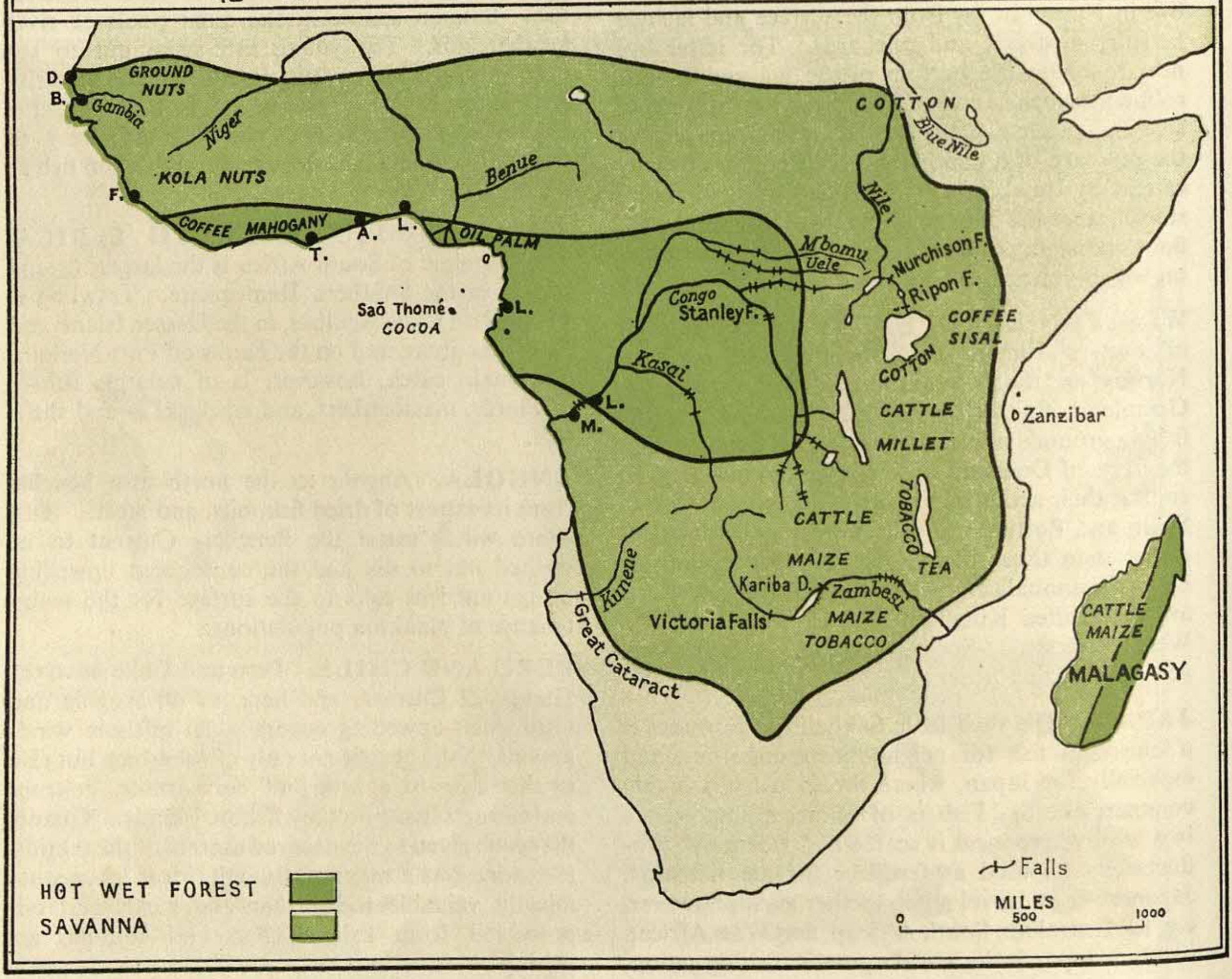
**PERU AND CHILE.** Peru and Chile have the Humboldt Current, and here, as off Angola and California, upwelling occurs when offshore winds prevail, to the benefit not only of fishermen but also in this case to colonies of cormorants, pelicans and gannets living on the offshore islands. Guano, the name given to the decayed excreta of these birds, is exported as a manure, though this is less economically valuable today than the meals and oils processed from fish. Callao and Iquique are fishing ports.

# Hot Wet Forests



MANAUS Jan. to Dec.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| °F. | 81 | 81 | 81 | 81 | 81 | 81 | 82 | 83 | 83 | 84 | 83 | 82 | |
| °C. | 27 | 27 | 27 | 27 | 27 | 27 | 28 | 28 | 28 | 29 | 28 | 28 | Total |
| ins. | 9·8 | 9·1 | 10·3 | 8·7 | 6·7 | 3·3 | 2·3 | 1·5 | 1·8 | 4·2 | 5·6 | 8·0 | 71 |



# Hot Wet Forests

Equatorial forest occurs in the Congo Basin, eastern Malagasy, the Amazon Basin, and parts of Central America, the West Indies, and the East Indies.

**CLIMATE.** The equatorial climate is characterized by high temperatures and heavy rainfall. Monthly means frequently reach 80° F. (27° C.), and since the sun is always high in the sky, annual range is less than 5° F. (3° C.). Rainfall is attributed to convection, and in the case of eastern coastlands to Trade Winds. Annual precipitation exceeds 60 inches. There is no month free from rain. Trade-Wind coasts frequently record over 100 inches, as in Malagasy. Two rainfall maxima correspond with the periods when the sun is passing overhead, though one maximum is invariably higher than the other, e.g. Manaus (p. 34). Some stations record only one maximum, for which there is no satisfactory explanation.

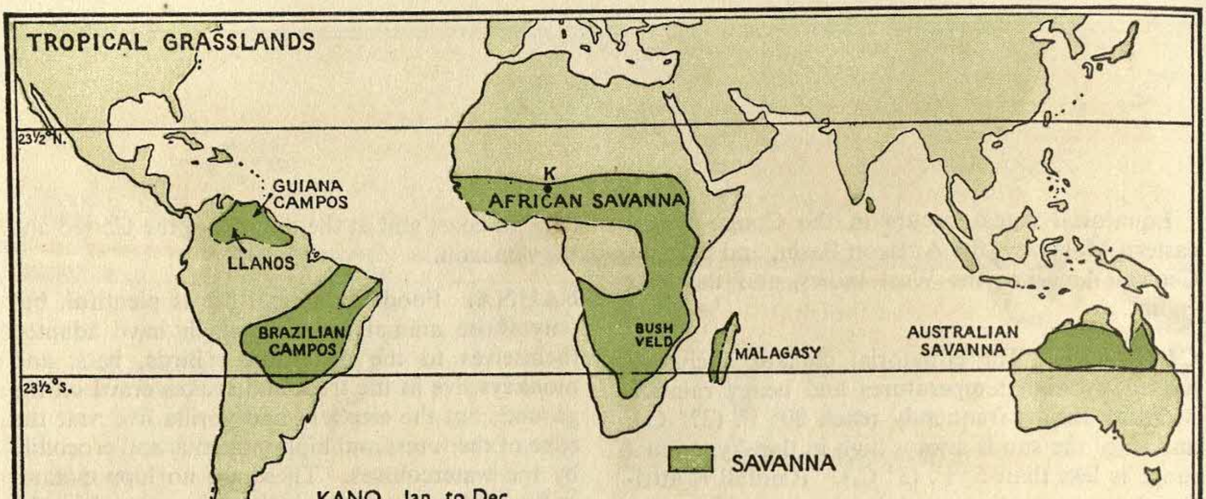
**VEGETATION.** Vegetation adapts itself to the wet conditions by shortening its roots and increasing its foliage. Leaves have thin skins, numerous stomata and long drooping points. The scramble for light causes trees to attain heights of 100 feet or more and to carry a vast canopy of leaves. On stems or branches grow epiphytes — plants rooted on other plants, some of which catch dripping water by a system of hanging roots — and parasites — plants not only rooted but feeding on the sap by means of suckers. There are numerous varieties of trees, the same type only occurring once or twice in an acre. Those content with less light grow beneath the taller ones — they include giant palms, tree ferns, and plantains. Many have adopted climbing habits, some thick, some thin, some epiphytic, some parasitic, many gorged with sap and known as lianes. Undergrowth is thin and weakly — fleshy saplings growing from a mush of dead leaves, coils of fallen lianes, and stumps of rotting trees. Such conditions are typical of the Amazon selva and of the Congo, but the tableland between the African rivers has a park landscape of light woods. In Central America the lowland forest is known as the tierra caliente. Coasts are fringed with mangroves, especially the West African coast and at the mouths of the Congo and the Amazon.

**FAUNA.** Food for animal life is plentiful, but only those animals survive which have adapted themselves to the conditions. Birds, bats, and monkeys live in the trees and snakes crawl on the ground, but the elephant and gorilla live near the edge of the forest and hippopotamus and crocodile by the watercourses. There are no hippopotami in South America; the elephant is replaced by the tapir, the crocodile by the alligator.

**NATIVE PEOPLES.** Native peoples are hunters, collectors, or trappers. Since they can never remain long in the same place, dwellings must be easily constructed. In Africa the pygmy home consists of a number of plantain leaves arranged in circular fashion with a hole at ground-level for entrance. Birds, ants, grubs, and wild beans serve as food. In the Amazon a thatched hut is built on poles, and hammocks made of fibres of palms hang inside and keep the natives off the damp and insect-infested ground. All are expert with bow and arrow and their knowledge of poisons and antidotes is amazing. The Amazonian Indian cultivates only sufficient for his immediate needs — rice, tapioca, mangoes — on a patch of ground among the trees. He possesses no knowledge of agriculture, and even the African Negro, who has penetrated the forest to some extent, shows only the most rudimentary ideas, and his crops are often destroyed by insects, monkeys, or torrential rain.

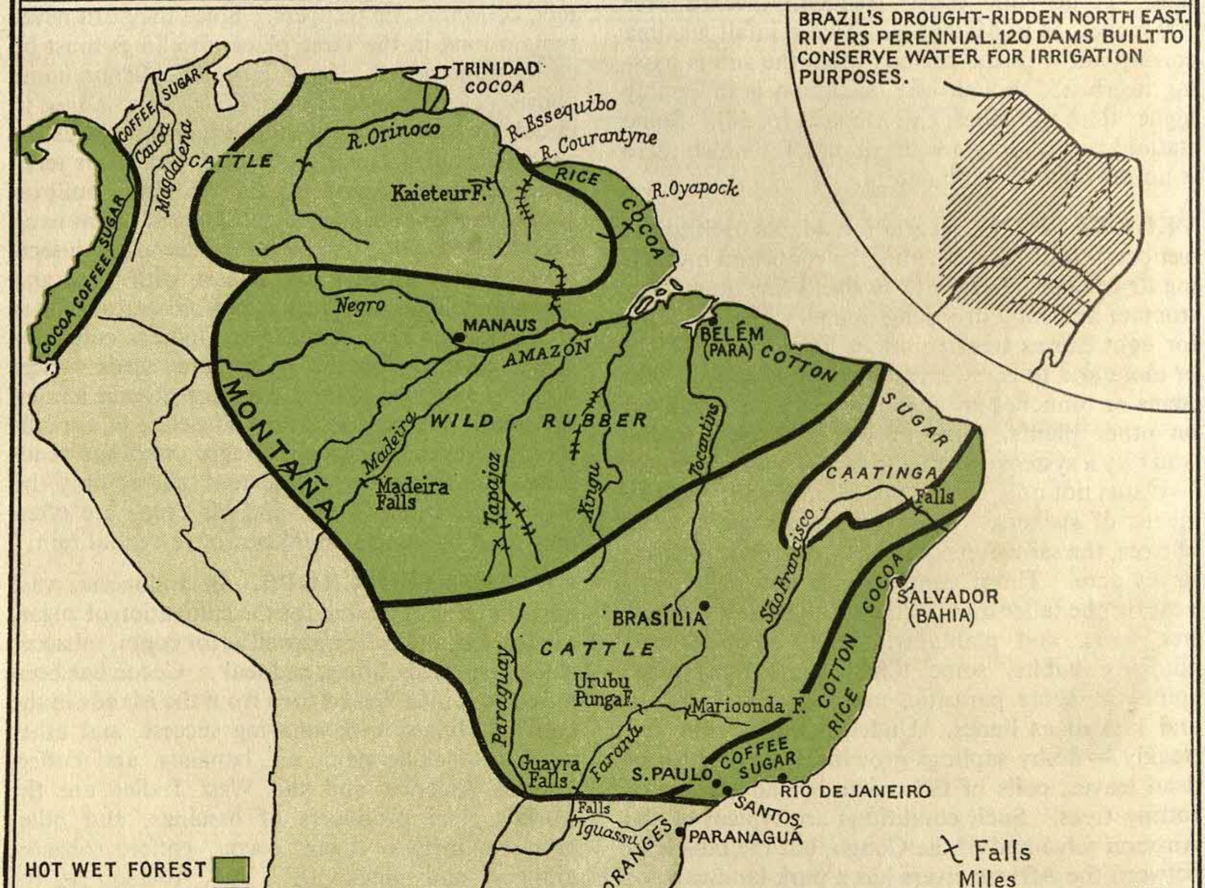
**CULTIVATED CROPS.** In Indonesia, vast areas have been cleared for the cultivation of sugar, rubber, tea, and coffee, as well as for copra, tobacco, cinchona, spices, fibres, and teak. Cocoa has been introduced into West Africa from the islands in the Gulf of Guinea with amazing success, and other products include palm oil, bananas, and coffee. Central America and the West Indies are the world's chief producers of bananas, and other products include sugar, cocoa, coffee, tobacco, oranges, and pineapples. The Amazon is the least developed, and although it has provided man with the rubber tree, production is less than 1 per cent of the world total.

# Tropical Grasslands



KANO Jan. to Dec.

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. °F. | 72 | 77 | 85 | 89 | 88 | 83 | 80 | 78 | 80 | 81 | 78 | 73 | |
| Temp. °C. | 22 | 25 | 29 | 32 | 31 | 28 | 27 | 26 | 27 | 27 | 26 | 23 | Total |
| Rain (ins.) | 0 | 0·1 | 0·1 | 0·5 | 2·5 | 4·8 | 8·2 | 12·1 | 5·5 | 0·5 | 0 | 0 | 34 |


BRAZIL'S DROUGHT-RIDDEN NORTH EAST. RIVERS PERENNIAL. 120 DAMS BUILT TO CONSERVE WATER FOR IRRIGATION PURPOSES.

# Tropical Grasslands

Tropical grasslands lie between the rain forests and hot deserts into which they merge. In Africa they extend in a belt round the forests from Senegal to the Sudan, through the plateau of the Great Lakes to some distance south of the Zambesi and back again to the Atlantic. In South America they are completely separated by the forest, the northern section being known as the llanos of the Orinoco plains and the Guiana campos of the Guiana tableland, and the southern as the Brazilian campos. In Australia they lie in a big arc between the northern coastal forest and interior desert.

**CLIMATIC CONDITIONS.** They are characterized by a cool, dry season lasting two to four months. The rain belt follows the sun, so that when the sun is overhead at Cancer in June the northern sections have their rainy season, while those south of the Equator have a dry season. Opposite conditions prevail in December. Average yearly rainfall varies from 40 to 60 inches. Mean monthly temperatures range from 65° to 80° F. (18° to 27° C.).

**VEGETATION.** The savanna is a landscape of tall grass some 6 to 10 feet high and dotted with occasional trees which give a park-like effect. The grass, which grows in compact tufts with an extensive root system, withers in the autumn to a yellow sponge of straw and serves to protect the roots from the hot sun. Trees adapt themselves by developing long roots, shedding leaves during the dry season, and storing water in their trunks. The African baobab, with a fleshy trunk some 10 to 30 feet in diameter, grows alone because of its vast root system. Umbrella-shaped trees with low flat crowns, corky bark and impervious leaves are common. Palms are confined to the river valleys since they cannot withstand a dry season. Interspersed in the grass are low bushes, some with hard leathery leaves, others prickly and bare. In Australia, where the savanna merges into desert, scrub becomes most frequent, such as the brigalow acacia with its hard sickle-shaped leaves, mallee scrub consisting of yellowish-brown eucalyptus bushes crowded together, and mulga made up of acacias in scattered groups or with a carpet of grass combining to form a dense thicket. Australian grasses include the kangaroo and spinifex. Sometimes there are no trees at all, as in parts of the Australian savanna and the Bush Veld south of the Zambesi. In the Brazilian campos, occupying the Brazilian tableland, trees are confined to the watercourses.

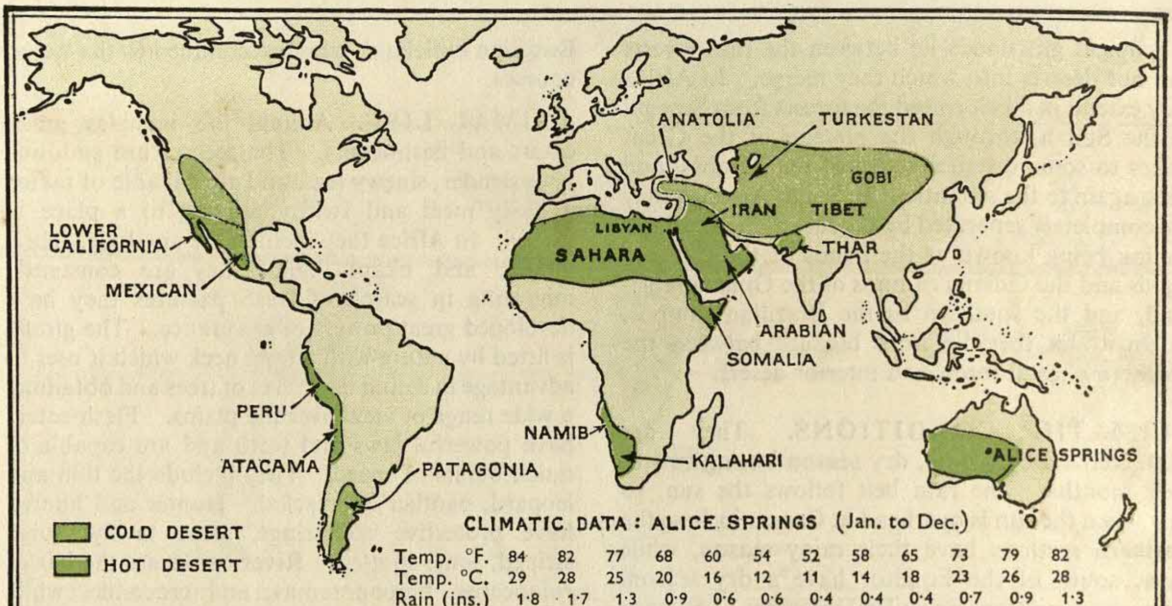
**ANIMAL LIFE.** Animal life includes grass-eaters and flesh-eaters. The former are endowed with slender, sinewy legs, and are capable of taking a hasty meal and swiftly moving to a place of safety. In **Africa** they include the antelope, zebra, giraffe, and okapi. Since they are constantly migrating in search of fresh pastures they have developed great powers of endurance. The giraffe is fitted by nature with a long neck which it uses to advantage in eating the leaves of trees and obtaining a wide range of view over the plains. Flesh-eaters have powerful jaws and teeth and are capable of quick bursts of speed. They include the lion and leopard, panther and jackal. Hunter and hunted have protective colourings, some tawny, some striped, some spotted. River banks are the lair of rhinoceros, hippopotamus, and crocodile, while elephants live on the edge of the forest. By contrast, the savannas of **South America** and **Australia** are singularly deficient in animal life.

**CATTLE-RAISING.** The savannas are used as pasturage for cattle. Those African countries which have a surplus, export animals on the hoof, and sometimes as meat. Chad, for instance, exports cattle on the hoof to the neighbouring countries of Nigeria, the Central African Republic and Cameroun, and meat by air to the Congo (Brazzaville) and the Gabon. Animals on the hoof constitute more than half the total exports of the Upper Volta, and great numbers pass through this country from the Republics of Niger and Mali to the consuming areas of the Ivory Coast and Ghana.

Cattle raised on the savannas of Queensland and the Northern Territory have raised meat production there sufficiently high for it to displace wheat as Australia's second export, though some of the meat comes from temperate grasslands. Bitumen-surfaced roads and a railway from Mount Isa to Townsville reduce the wastage formerly entailed by walking beasts to market.

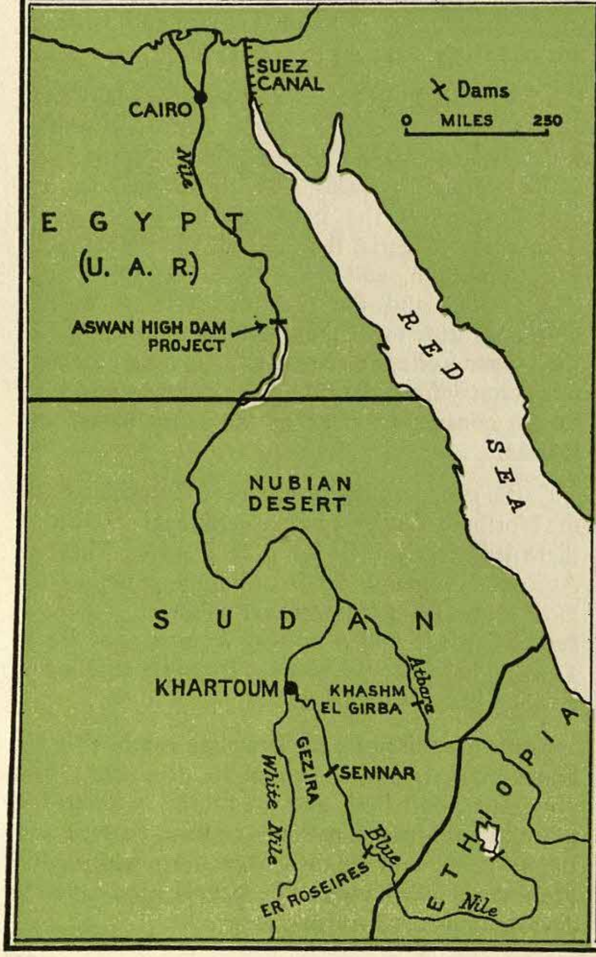
Cattle are raised on the Brazilian campos for the home market, and in order to produce a type providing good flesh and yet retaining high resistance to heat, native cattle have been crossed with Indian zebu, and English Shorthorn with Indian Brahman. The llanos of Venezuela have yet to be developed as cattle-raising areas.

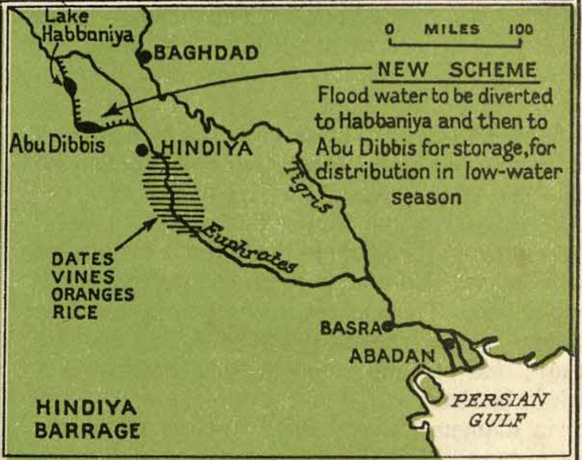
# Hot Deserts



CLIMATIC DATA : ALICE SPRINGS (Jan. to Dec.)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. °F. | 84 | 82 | 77 | 68 | 60 | 54 | 52 | 58 | 65 | 73 | 79 | 82 |
| Temp. °C. | 29 | 28 | 25 | 20 | 16 | 12 | 11 | 14 | 18 | 23 | 26 | 28 |
| Rain (ins.) | 1·8 | 1·7 | 1·3 | 0·9 | 0·6 | 0·6 | 0·4 | 0·4 | 0·4 | 0·7 | 0·9 | 1·3 |

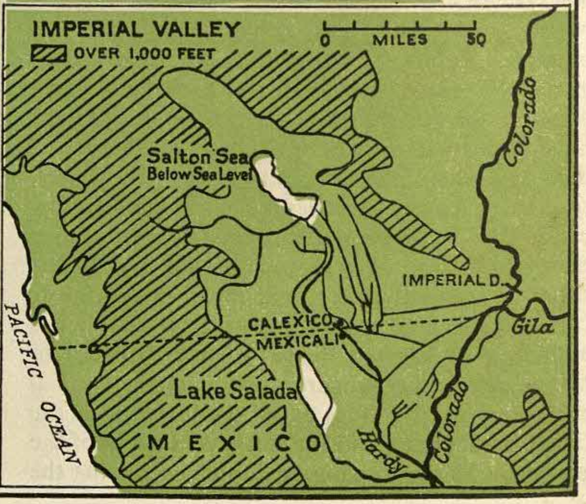




NEW SCHEME
Flood water to be diverted to Habbaniya and then to Abu Dibbis for storage, for distribution in low-water season

HINDIYA BARRAGE

IMPERIAL VALLEY



# Hot Deserts

Hot deserts lie in Trade-Wind latitudes (p. 38).

**TEMPERATURE.** They record the world's highest temperatures. Monthly means for the hottest month in interior locations frequently exceed 90° F. or 32° C. (e.g. In Salah in Algeria, 98° F. or 37° C.), though stations at higher elevations have lower temperatures (e.g. Alice Springs in Australia, 84° F. or 29° C.). Clear skies foster intense insolation in summer and considerable loss of heat in winter. Even so, the high annual range is caused, not so much by low winter temperatures, as by the extremely high summer temperatures. In Salah has a range of 44° F. (25° C.), Alice Springs 32° F. (17° C.) One of the characteristics of a hot desert is the absence of a cold season. Mean monthly temperatures never fall below 40° F. (4° C.).

Coastal stations, washed by cold currents, have cooler summers. Thus Walvis Bay in the Namib, washed by the Benguela Current, records 66° F. (19° C.), and Iquique in the Atacama, washed by the Humboldt Current, records 71° F. (22° C.). This also reduces the annual range, e.g. Walvis Bay 9° F. (5° C.), Iquique 11° F. (6° C.).

**RAINFALL.** Precipitation is low. Subsiding air, typical of the hot desert, results in adiabatic heating and low humidity. The presence of high ground, however, may induce some precipitation, as in the Ahaggar Mountains of the Sahara and the highlands of the Yemen. For the same reason Alice Springs has an annual rainfall higher than most desert stations.

Coastal stations receive offshore winds, and although fog is caused by the chilling of the air as it passes over a cold current, it is warmed again on reaching the hot land surface, and no condensation occurs. Nevertheless, some fog may roll inland and support the growth of a scanty vegetation.

**VEGETATION.** Few deserts are entirely devoid of vegetation, but what little does exist must adapt itself to long periods of drought, e.g. by the use of hard surfaces to prevent excessive transpiration, fleshy stems to store water, and by an extensive root system.

**TYPES OF DESERT.** **Sandy desert**, known as erg, consists of sheets of sand or lines of sand dunes. **Rocky desert** or hamada consists of a rocky surface free from sand. **Stony desert**, or reg, consists of angular gravels and pebbles caused by the disintegration of rocky desert.

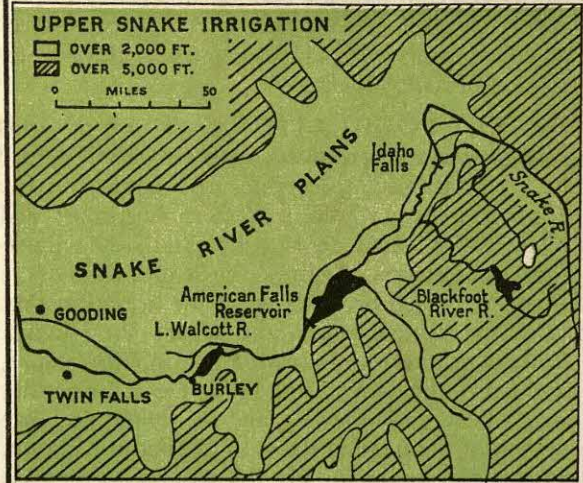
**DESERT POPULATIONS.** Where minerals exist they can be exploited, such as sodium nitrate in the Atacama; lead, zinc, and copper in the Mexican Plateau; gold in Western Australia; and oil in the Arabian desert. Irrigation may transform a desert area — witness the Sennar Dam of the Blue Nile which provides water for the cultivation of cotton, wheat, maize, and sugar; the Hindiya Barrage of the Euphrates for cotton, rice, maize, and fruit; the dams of the Indus Basin for cotton, rice, wheat, and oilseeds; and the inland drainage system of the Laguna Basin in Mexico for cotton, wheat, and maize (p. 40). A scheme to increase the supply of water to Egypt and the Sudan is that of the Aswan High Dam.

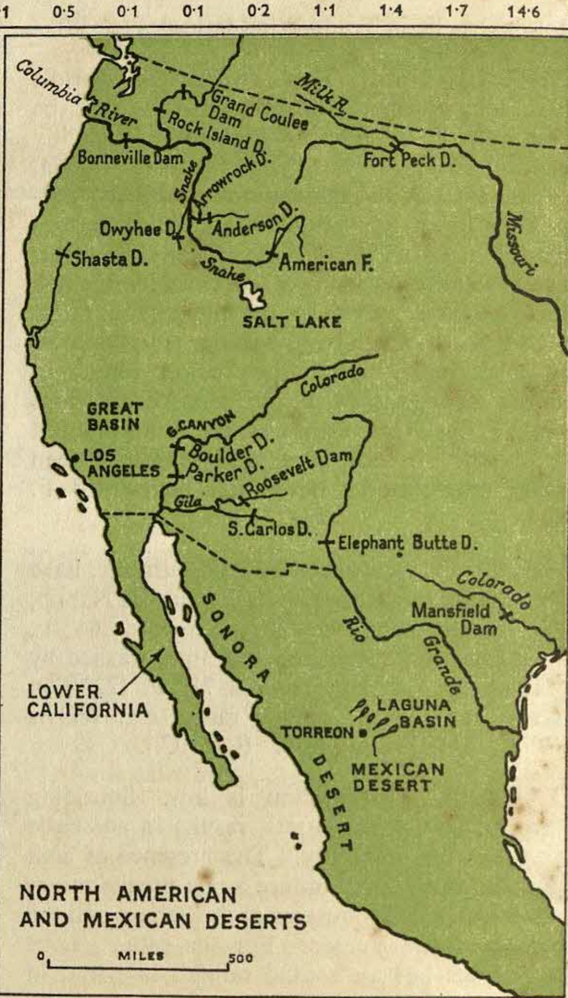
**MODES OF DESERT LIFE.** The **Bushman** of the Kalahari is a 'collector', with no settled habitation, a cave sufficing as shelter, and ants' eggs, grubs, snakes, and roots as food. Lack of these make him a hunter and he will patiently stalk an antelope, taking cover behind bushes or crawling along the ground until he is near enough to deliver his poisoned arrow. He can go for long periods without water and is skilful in locating an underground supply.

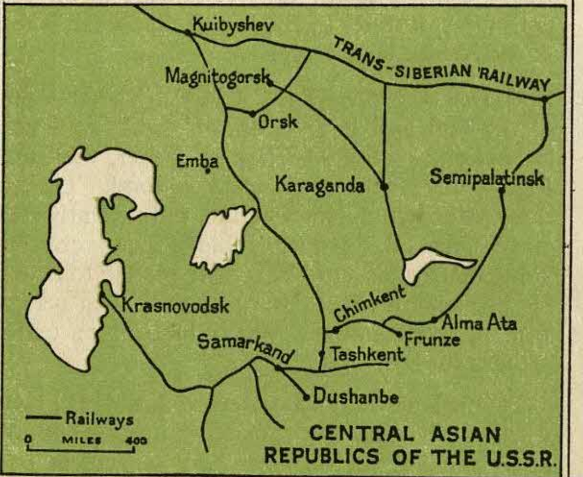
The **Bedouin** of the Sahara and Arabia is a tent-dweller. To him the camel is indispensable. Its large padded feet facilitate easy movement over the sand. It can travel long distances without food or water. Reserve food is stored in the hump, which comes and goes without the health of the animal being affected, and a good driver takes care that the hump is healthily filled before proceeding on a long journey. Its stomach is lined with tiny water-cells which are filled when the camel drinks and automatically closed for future use. The camel supplies the Bedouin with milk, and with hair for making carpets. These can be exchanged for food, clothing, and firearms. The tent is a framework of poles covered with goats' hair. Clothes are woollen, a cloak and hood all in one, giving protection from the heat of day and the cold of night. Food consists of dates and roasted flour eaten at night, two draughts of milk during the day, and meat on special occasions.

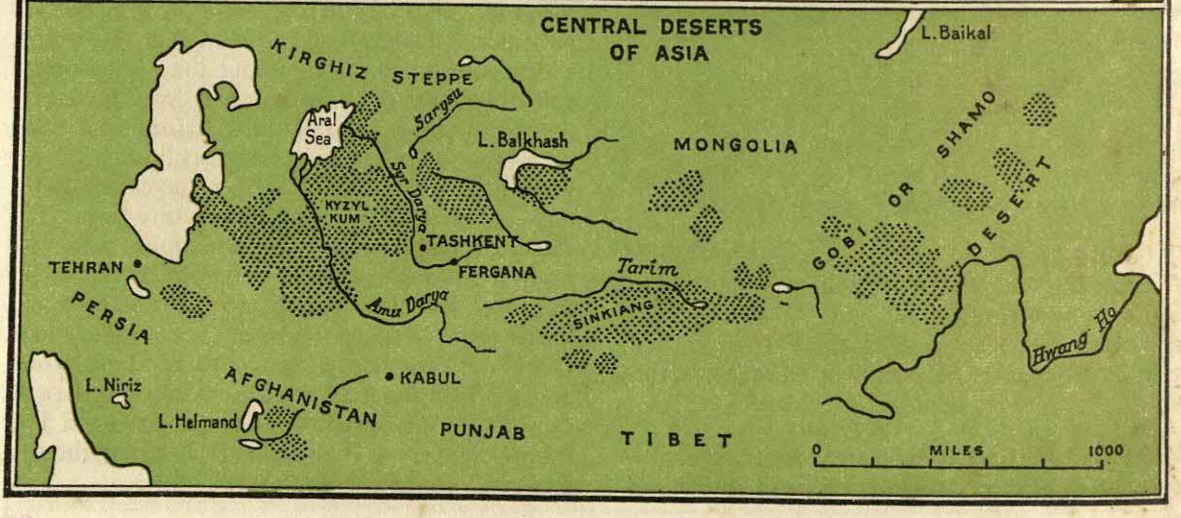
# Cold Deserts

| TASHKENT (Jan. to Dec.) |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Temp. °F. | 30 | 34 | 47 | 58 | 70 | 77 | 81 | 77 | 66 | 53 | 43 | 36 |  |
|  | Temp. °C. | –1 | 1 | 8 | 14 | 21 | 25 | 27 | 25 | 19 | 12 | 6 | 2 | Total |
|  | Rain (ins.) | 1·8 | 1·4 | 2·6 | 2·6 | 1·1 | 0·5 | 0·1 | 0·1 | 0·2 | 1·1 | 1·4 | 1·7 | 14·6 |









# Cold Deserts

Cold deserts occupy interior areas of continents in middle latitudes. It is this location, far removed from oceanic influences, that constitutes the chief climatic control.

**TEMPERATURE.** In summer the land mass becomes hot and temperatures may rise as high as those of the hot desert. In winter the land mass becomes cold, with temperatures frequently falling below freezing-point, e.g. Tashkent (p. 40). Annual temperature range, therefore, is considerable. As in the hot desert, diurnal range is high, because clear skies permit intensive insolation during the day and rapid radiation by night.

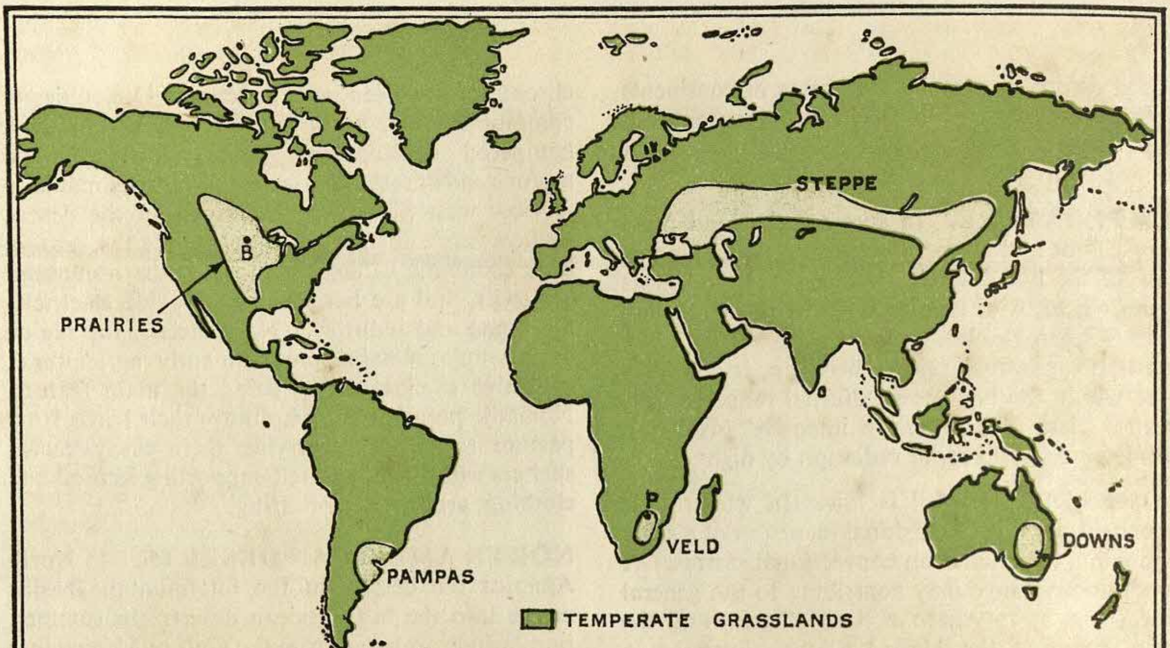
**RAINFALL.** Rainfall is low. In winter it is dependent upon the occasional incursion of a stray depression, in summer on convectional storms. A mountainous fringe may contribute to the general desiccation, as in Anatolia, Iran (Persia) and the Great Basin of the United States. Even so, a rainfall of 6 to 8 inches is more effective in the cold than in the hot desert, since evaporation and transpiration are lower, frequently sufficient to support a poor steppe.

**ASIATIC DESERTS.** Such conditions can normally only support nomadic populations. In Iran and Anatolia flocks of sheep, goats, and camels feed on the mountain pastures in summer but must be housed in the valleys in winter. The region long known as Russian Turkestan — the Kirghiz steppe and the arid lands as far south as the mountain borders of Iran and Afghanistan — now consists of five republics, each with its own capital, and known collectively as the Central Asian Republics of the U.S.S.R. The steppe, especially on its northern fringe, produces grain and beef, but southwards fertility decreases to give the Kyzyl Kum, a region of shifting sand-dunes and clayey depressions. Beyond this, however, fertile oases exist, notably in the Fergana Valley between Tashkent and Samarkand, and these are under irrigation. Much of the true desert remains uncultivable, but the production of cotton and silk has been stepped up enormously, with Tashkent the hub of the cotton industry. Of enormous value is the great mineral wealth, mined, smelted, and refined in the region, and which has produced big urban populations. Copper, lead, and zinc are the chief minerals. There is excellent-quality coal, some oil, and a host of other minerals such as chromium, tungsten, and mercury. Difficulties of communications, both without and within, long hampered development. Today, railways and motor-roads cross the desert and airlines maintain services with Moscow. The rivers of the desert, shallow and obstructed with sandbanks, are of little economic value, but those of the mountains are swift, and are harnessed to provide electricity for home and industry. Nevertheless, the region as a whole remains predominantly agricultural, collective stock-breeding being the main feature. Nomadic populations, who move their herds from pasture to pasture, carrying their easily-erected shelters with them, and self-supporting in food and clothing, are fast disappearing.

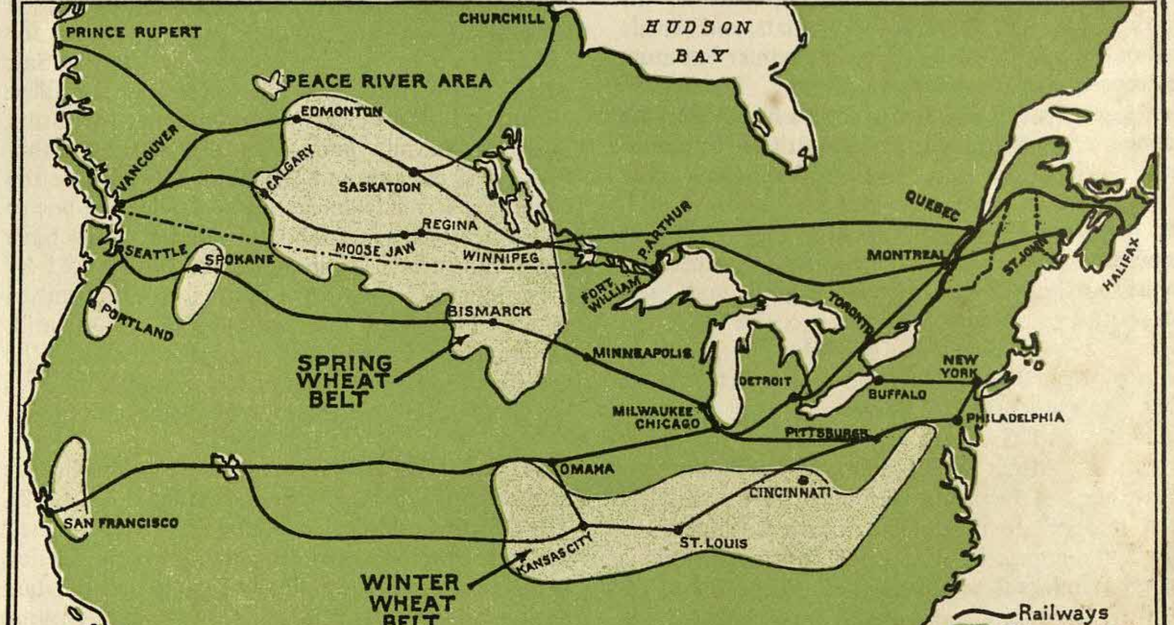
**NORTH AMERICAN DESERTS.** In North America the deserts of the intermontane basins merge into the hot Mexican desert. In summer, rainy winds drawn in from the Gulf of Mexico lose their moisture over the plains of Texas. In winter, winds are either offshore or are cut off by the high Western Cordillera. Where the Colorado reaches the Gulf of California (p. 38), the desert has been transformed into a region producing wheat and fruit, with Calexico the American centre and Mexicali the Mexican. Further north the dammed Colorado Canyon at Boulder provides power for coastal town and mining community, and the Salt River, power and irrigation water for its valley. Northwards the desert is continued as the Great Basin of Nevada and Utah and the Columbia Plateau of Oregon and Washington, and here the Columbia River is harnessed at Coulee for power and irrigation. In Idaho the Snake Plains have been transformed from desert to fertile field by irrigation water, with prosperous farming centres such as Twin Falls and Gooding. Farm, sawmill, and mine are supplied with electric current, and the soil, fertilized by nature with volcanic ash, gives big yields of onions, potatoes, hay, wheat and fruit.

**SOUTH AMERICA.** A temperate desert exists in the Southern Hemisphere — Patagonia (p. 38). The North-westerlies, depleted of much of their moisture over the Andes, are warmed by compression in their descent to the plains and can therefore retain any remaining water vapour. Consequently they are drying winds, and since little high ground exists to cause precipitation, the region is one of low rainfall, supporting a poor steppe on which sheep are grazed.

# Temperate Grasslands: Northern Hemisphere



| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BISMARCK | °F. | 7 | 10 | 23 | 43 | 54 | 63 | 69 | 68 | 58 | 45 | 27 | 15 | |
| | °C. | −14 | −12 | −5 | 6 | 12 | 17 | 21 | 20 | 14 | 7 | −3 | −9 | Total |
| | ins. | 0·5 | 0·5 | 1 | 2 | 2·5 | 3·5 | 2 | 2 | 1 | 1 | 0·5 | 0·5 | 17 |
| PRETORIA | °F. | 72 | 71 | 68 | 62 | 57 | 53 | 52 | 57 | 63 | 68 | 69 | 71 | |
| | °C. | 22 | 22 | 20 | 17 | 14 | 12 | 11 | 14 | 17 | 20 | 21 | 22 | |
| | ins. | 5·5 | 4 | 3·5 | 1 | 0·5 | 0 | 0 | 0 | 1 | 2 | 4 | 4 | 26 |



# Temperate Grasslands: Northern Hemisphere

Temperate grasslands occupy interior locations in the continents, except in the case of the pampas where they extend to the sea. In Russia they are known as the steppe, in North America as the prairie, in Australia as the downs, in southern Africa as the veld, and in South America as the pampas. The term 'steppe', however, is generally applied to all of them.

**CLIMATE.** Climate is extreme, especially in the Northern Hemisphere, because of their great distance from the ocean, e.g. Bismarck (p. 42). Winters are less cold in the Southern Hemisphere and snow almost unknown. Annual rainfall varies from 10 to 30 inches, e.g. Pretoria (p. 42).

**VEGETATION.** In its natural state the steppe had a continuous carpet of tufted grass, bluish-green in spring, yellow to brown in summer, and tufted with feathery spikes. Insufficient rainfall and competition from rapidly growing grasses prevent tree-growth, a feature which distinguishes it from the savanna.

**ECONOMY.** Few areas retain their natural vegetation. Almost everywhere they are used for grain and livestock. Early summer rain in the growing-season and a late sunny summer for ripening and harvest favour the cultivation of wheat and other cereals. Their gently rolling surfaces are ideal for the use of the machine. Where livestock is reared, native grasses are usually replaced by alfalfa and other nutritive types.

**EURASIA.** The dry steppes of Asia favour a pastoral economy, as pursued by the Kirghiz, who wander from pasture to pasture with their cattle, sheep, and horses, carrying with them their easily-erected dwellings. The Russian black earth of the European section, however, has long been cultivated for wheat, and now the Asiatic sector contributes its share.

**NORTH AMERICA.** Wheat is grown throughout the North American grassland. In the north — in Alberta, Saskatchewan, Manitoba, and the Dakotas — it is spring-sown. Saskatchewan is the leading Canadian province. Climatic conditions are not ideal, but it is the most profitable crop. By breeding wheats capable of maturing in 110 days, the northern boundary has been extended to the Peace River area.

Further south in Kansas and Nebraska, autumn-sown wheat is grown, and by use of drought-resisting types the belt has been extended into the Great Plains. The winter-wheat belt, as this region is called, also extends eastwards beyond the confines of the steppe into the Appalachians. Kansas is the leading American state. The United States and Russia lead the world in wheat production.

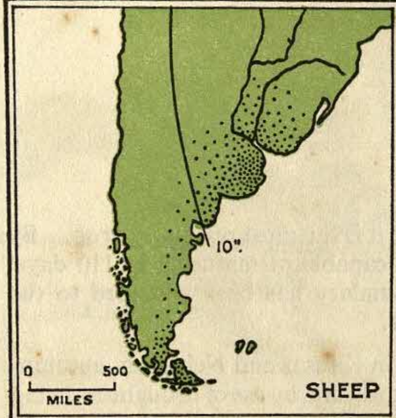
Canada is the leading exporter, however, since she has a smaller population to feed. Winnipeg is one of several milling centres. Wheat travels by rail to the Lakehead, the name given to the combined harbours of Port Arthur and Fort William, and is shipped direct to Montreal and Quebec, now that the St. Lawrence Seaway between Lake Ontario and Montreal is in operation. Some goes to Vancouver, and in the summer to Churchill, since the latter is considerably nearer to Europe than Montreal.

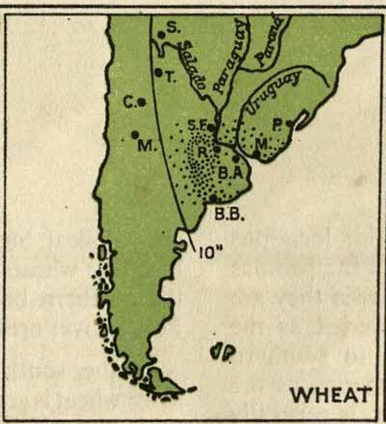
American wheat has various outlets: (*a*) from Duluth by steamer to Buffalo and thence by rail to New York, (*b*) directly by rail to Philadelphia and Baltimore, and (*c*) southwards to New Orleans.

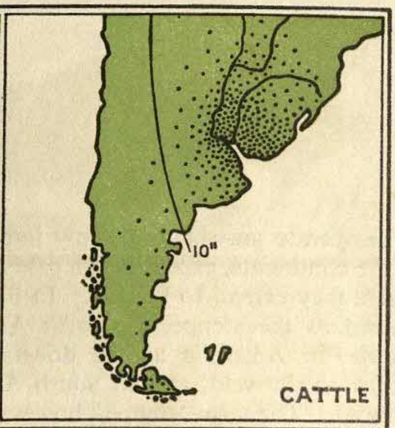
The Great Plains to the west of the Mississippi from Alberta to Texas constitute one of the world's largest grazing-grounds. Whiteface cattle are popular, but a breed to suit the hotter south has been evolved by crossing native with Brahman cattle. Texas carries more cattle than any other state. Nebraska and Kansas also record large numbers. The cattle of these and other areas help to maintain the United States' lead in beef production, though here again Russia is almost as important.

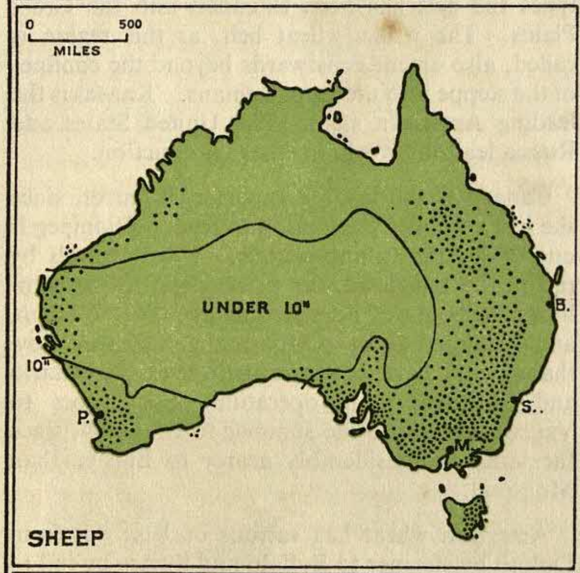
Sheep are less remunerative than cattle. Nevertheless, they are kept in some parts of the Great Plains since they can withstand longer periods without water and survive on vegetation unsuitable to cattle.

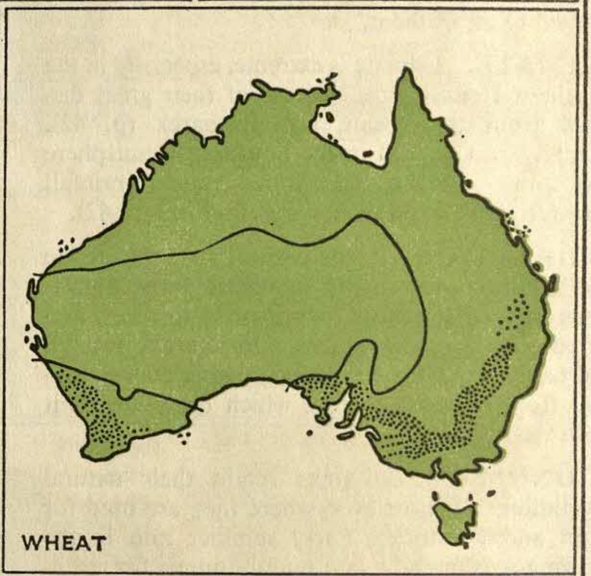
# Temperate Grasslands: Southern Hemisphere

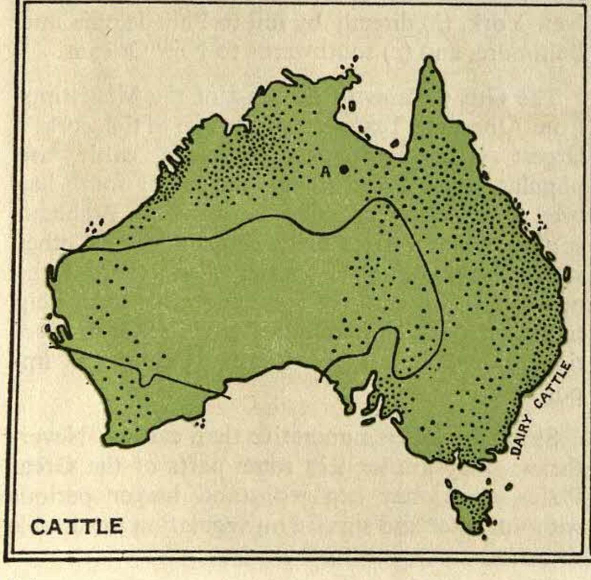


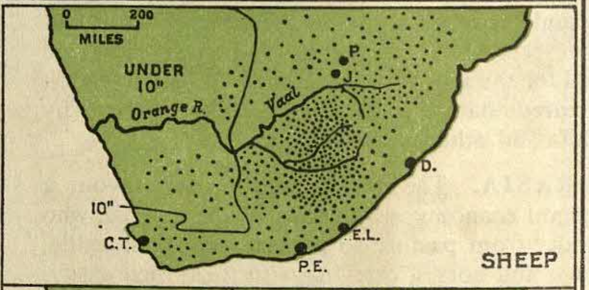


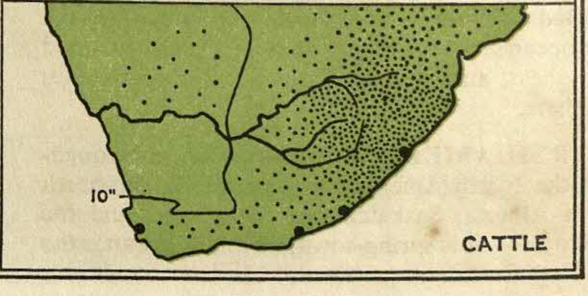












# Temperate Grasslands: Southern Hemisphere

Although the southern grasslands show similar general characteristics, there are certain prominent differences, e.g. (*a*) the pampas have a heavier and more evenly distributed precipitation, (*b*) the veld is a plateau some 4,000 to 6,000 feet high, rising in big rolling waves relieved here and there by big masses of rock (kopjes) and contrasting with the almost level character of the pampas and downs. Rainfall diminishes in all cases from east to west, 38 to 28 in. in the pampas, 20 to 10 in. in the veld and downs, and is generally insufficient for most trees, though the drought-resisting eucalyptus dots the Australian landscape and has been introduced to the pampas and downs.

The **sheep** is adapted by its fleece to temperate climates and does well where temperatures average 65° to 75° F. (18° to 24° C.). Wet conditions bring on foot-rot, so that the wetter areas of Queensland and the northern pampas are more suitable to cattle. In Australia the main sheep area extends from Queensland in a big arc some 300 miles wide, running parallel with the coast on the leeward side of the Eastern Highlands to south-west Victoria. In the pampas sheep are more prominent south of the Plate estuary, and in the same way that the sheep area encroaches on the Western Desert of Australia, so is it being extended into Patagonia.

Australia accounts for 29 per cent of the world's wool, the Soviet Bloc and New Zealand 14 and 10 per cent respectively. Argentina, South Africa, the United States, and Uruguay come next.

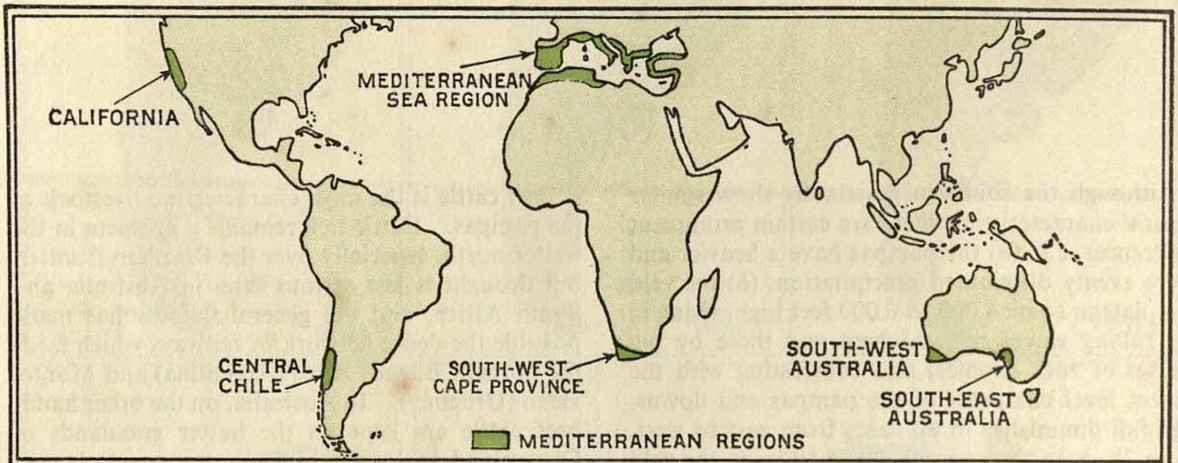
**Wheat** occupies the better part of the sheeplands where rainfall is between 10 and 20 inches, so that in Australia it grows best on the eastern side of the 'sheep arc', in South America in a curve between Bahia Blanca and Santa Fé, and in South Africa in valleys such as the Caledon. At one time the grasshopper was a serious problem in the pampas and rust another, but the former is almost exterminated and the latter overcome by the introduction of rust-resisting wheats.

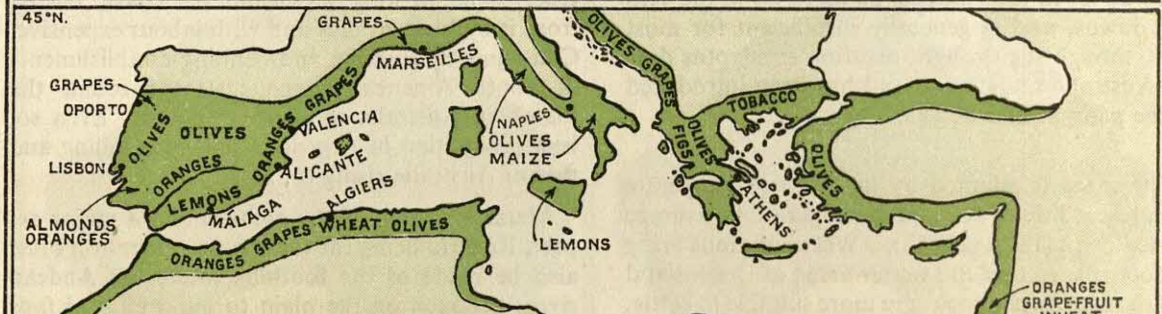
**Beef cattle** is the most characteristic livestock of the pampas. Cattle tick remains a problem in the wetter north, especially over the Brazilian frontier, but drought is less serious than in Australia and South Africa, and the general flatness has made possible the dense network of railways which feeds the ports of Buenos Aires (Argentina) and Montevideo (Uruguay). In Australia, on the other hand, beef cattle are kept on the hotter grasslands of Queensland, a long way from the coast, barred from it by high ground and with labour expensive. Consequently freezing and canning establishments in South America are concentrated round the Plate; in Australia they are scattered. Even so, beef production in Argentina has been falling and that of Australia rising (p. 37).

**Maize** is a crop of the pampas and a major export, Rosario being the main port. Mention must also be made of the foothills where the Andean rivers debouch on the plain to build alluvial fans (Salta, etc.), and which are used for the irrigation of **fruit** (grapes, plums, peaches, apricots, oranges, cherries) and **sugar**. The native sugar has been replaced by Java with good results, the wine industry is prosperous, and fruit-canning is likely to become more important. In Australia little maize is grown on the grasslands, and while it is grown all over South Africa, there is little export.

**Drought** is the most serious drawback on the downs and veld. Fortunately Australian grasses are highly nutritious, and the salt bush which provides fodder for sheep can withstand the most arid conditions. Consequently there has been less tendency to introduce alfalfa grasses as in the pampas, where the native pampa-grass is poor. Alfalfa is invaluable in times of drought because of its extensive root system; it can be cropped six or seven times without re-sowing, and is excellent for fattening cattle. Nevertheless, the Australian farmer is often faced with drought and he must meet it by conserving water and hay, stocking judiciously, and by sinking wells. In spite of these and other difficulties, Australia maintains her position as leading wool producer.

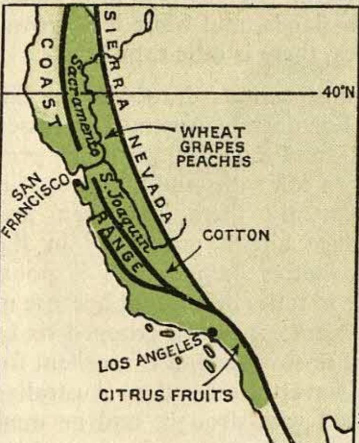
# Dry Subtropical Western Margins (Mediterranean)

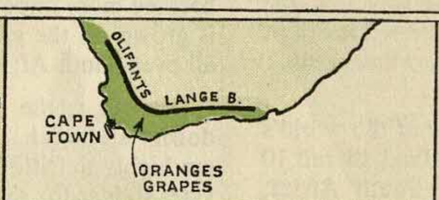


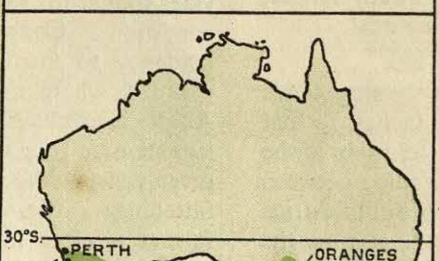


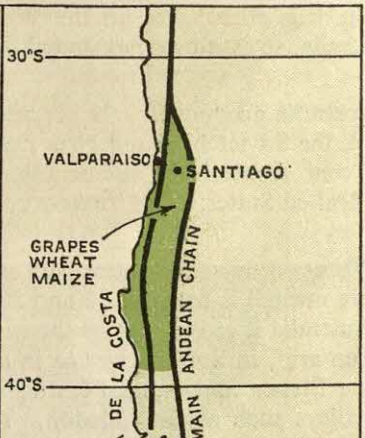
CLIMATIC DATA: SANTIAGO (Jan. to Dec.)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. °F. | 69 | 68 | 64 | 59 | 52 | 47 | 48 | 50 | 55 | 58 | 63 | 67 | |
| Temp. °C. | 21 | 20 | 18 | 15 | 11 | 8 | 9 | 10 | 13 | 14 | 17 | 19 | Total |
| Rain (ins.) | 0·1 | 0·1 | 0·2 | 0·5 | 2·5 | 3·3 | 3·0 | 2·2 | 1·2 | 0·6 | 0·3 | 0·2 | 14 |









# Dry Subtropical Western Margins (Mediterranean)

The **Mediterranean Climate** is characterized by winter rain and summer drought. It occurs between 30° and 45° latitude on **western** sides of continents (p. 29). In winter the shift of the wind belts brings the regions within the westerly wind belt. This is the cause of rain. In summer they lie in the high-pressure belt of the horse latitudes. The absence of onshore winds or their failure to bring rain after passage over a cold current on to a warmer land mass explains the dry summer. Temperatures rise from about 45° to 55° F. (7° to 13° C.) in winter to 70° to 80° F. (21° to 27° C.) in summer. Annual rainfall ranges from about 20 to 30 inches.

**VEGETATION.** Winter is the season of growth, yet trees remain evergreen throughout the summer. Devices to resist drought include the use of long tap-roots and small, waxy, spiny, or hairy leaves to reduce transpiration. Degeneration of the forest by man and his animals has produced an impoverished woodland of stunted trees and bushes, known in Europe as **maquis** and in California as **chaparral**. Grassland is unusual. Where it exists it consists of wiry types. The olive is typical of the Mediterranean Sea area and has been introduced into other areas. Wheat is grown in all areas. Some are more associated with the vine and citrus fruits, though these are nowhere indigenous.

The **Mediterranean Sea area** is famous for citrus fruits, grown under irrigation, especially in the coastal lowlands of Spain and Italy, countries which rank next to the United States and Brazil in annual production of oranges, and in Sicily, whose production of lemons rivals that of the United States. Citrus fruits cannot tolerate frost, and for this reason are usually planted on sloping ground. Air drainage is also necessary for the olive, though this tree is more tolerant of frost and can survive on 8 inches of rainfall. The Mediterranean is the world's chief source of olive oil (Spain, Italy, Portugal, Turkey, Algeria, Tunisia, Syria). France, Italy, Algeria, Spain, and Portugal also furnish 75 per cent of the world's wine (p. 64), though much of that produced in France lies outside the Mediterranean. Wheat and barley are grown for local consumption, and in a few localities such as the Po Valley and Ebro Delta, rice. The grasses are usually too poor for cattle but are satisfactory for sheep and goats.

**Southern California** is the least frosty part of the state. It accounts for 75 per cent of all Californian oranges, and all its lemons. Especially noteworthy is the piedmont of the San Bernardino–San Gabriel ranges. The plain is used for alfalfa, grains and sugar beet; the lower slopes where light frosts occur for grapes and peaches; and higher up, the sensitive orange and the more sensitive lemon. Olives are grown, though not on the same scale as in Europe. The Great Valley is cut off from marine influences by mountain ranges and has a more extreme climate. It is a source of grapes and wheat, and in the south, cotton.

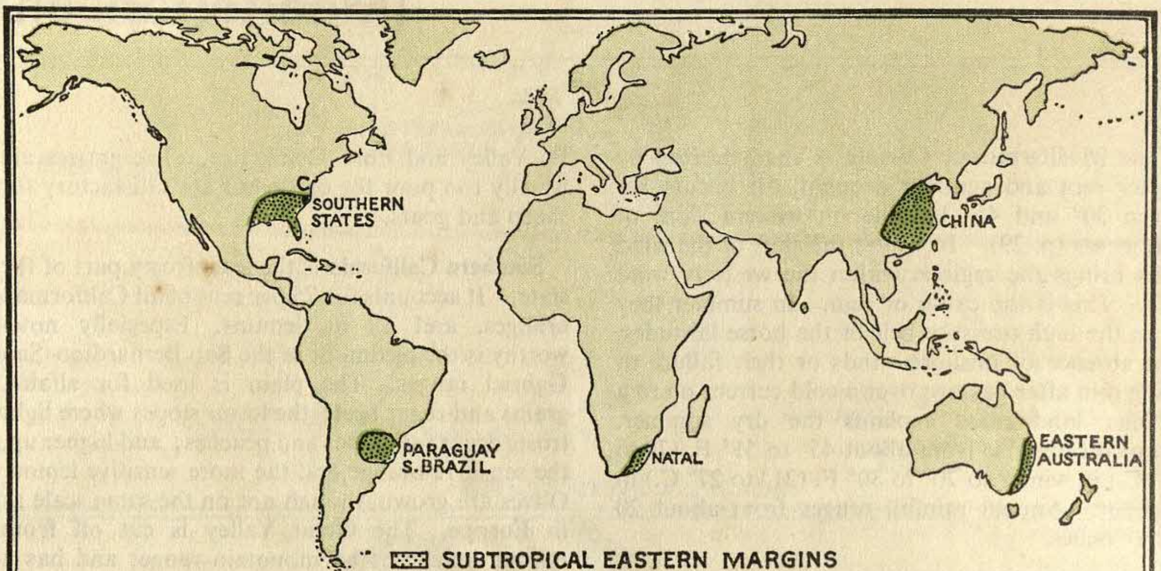
The **Central Valley of Chile** is a long way from world markets, and the cold Peruvian or Humboldt Current prevents the successful cultivation of some citrus fruits. Excellent grapes are produced and wine is exported to the Unites States and Europe. Wheat, maize, and potatoes are grown, and sugar beet and sunflowers have been introduced, but food production is unequal to demand and has to be supplemented by imports.

Viticulture in the **Republic of South Africa** is confined to its Mediterranean area. Citrus fruits, wine, and brandy are exported. Other crops are wheat and tobacco. The extent of the lowland is curtailed by the Olifants Mountains and the Langeberge. Sheep and goats are restricted to its margins.

The **Spencer Gulf area of Australia** is a wheat- and fruit-growing area. Grapes are grown in the valleys of the Lofty Ranges and Adelaide Hills. They account for 70 per cent of all Australian wines. Fresh and dried fruit are also exported.

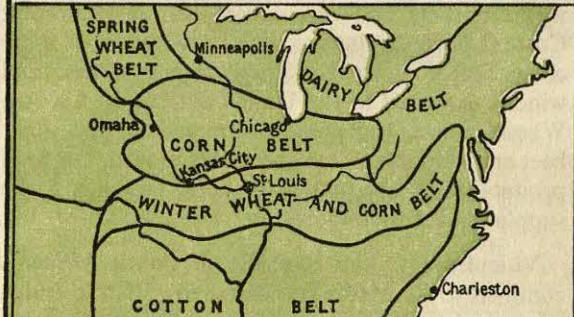
The **south-west of Western Australia** is more concerned with dairying, wheat, and apples. Grapes enter the export trade, but wine production is solely for home consumption, and there is little citrus-fruit production other than in a small area north of Perth where it is associated with sheep-farming. Dairy and stock ranges use 95 per cent of the irrigation water.

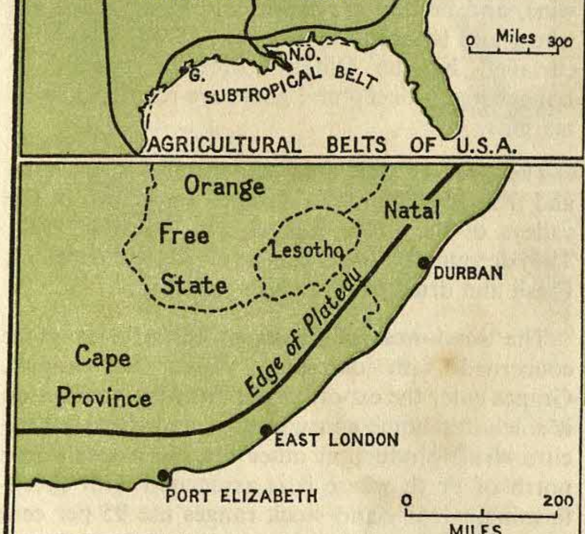
# Subtropical Eastern Margins

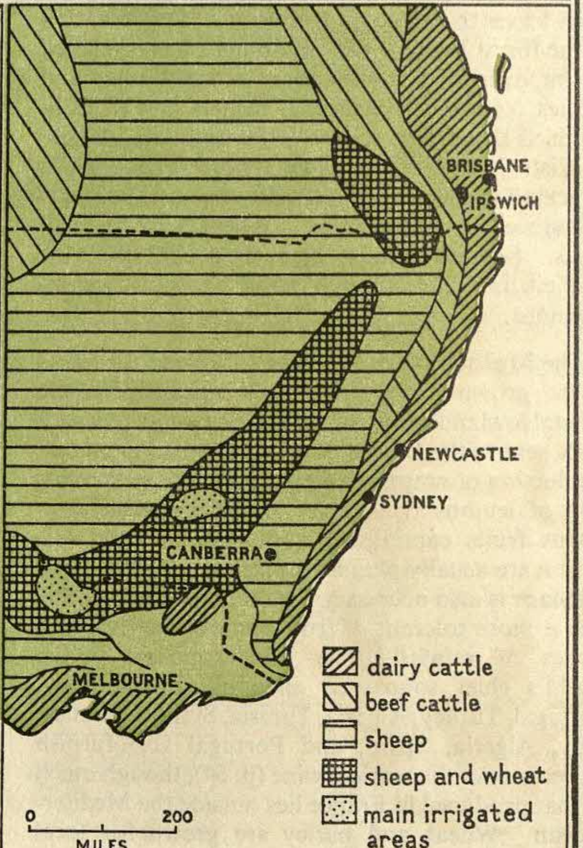


CHARLESTON (Jan. to Dec.)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. °F. | 49 | 52 | 57 | 64 | 72 | 79 | 81 | 80 | 76 | 67 | 58 | 51 | |
| Temp. °C. | 9 | 11 | 14 | 18 | 22 | 26 | 27 | 27 | 24 | 19 | 14 | 11 | Total |
| Rain (ins.) | 3·1 | 3·1 | 3·3 | 2·4 | 3·4 | 5·3 | 6·2 | 6·7 | 5·2 | 3·9 | 2·7 | 3·3 | 49 |







# Subtropical Eastern Margins

**CLIMATE.** Temperatures are similar to those of the subtropical western margins, since they lie in the same latitudes, but because of the high humidity, summers are more like those of the equatorial climate. Mean monthly temperatures for the warmest month are around 78° F. (26° C.) for most stations. Those for the coldest month average 40° to 55° F. (4° to 13° C.), though penetration of cold air from the margins frequently lowers temperatures below freezing-point.

Annual rainfall averages 30 to 65 inches. Some rain falls in every month, except in the Chinese region which has a distinctly dry season, namely, when winds blow from the Asiatic high-pressure belt.

**VEGETATION.** The well-distributed rainfall supports a semi-deciduous forest, more open than the selva, with a denser undergrowth. On its drier margins it gives way to tall grasses.

**THE NORTH AMERICAN REGION.** Except for the south coastal belt which is associated with rice and sugar cane, and Florida which is noted for its citrus fruits and truck farming, the region is known as the Cotton Belt. The cultivation of cotton is now limited to a few favoured tracts, about one-tenth of the total area. Even so, the warm springs with their frequent showers, the hot summers and the long dry autumns are favourable to its cultivation. Unfortunately, climatic conditions are also favourable to the boll weevil, and measures must be taken to check its activities.

The most fruitful achievement has been the use of Brahman bulls for the breeding of hybrid cattle which can withstand heat and insect attack. Cattle graze in lush pastures on land where hoe-hands were once engaged in keeping the grass out of the cotton.

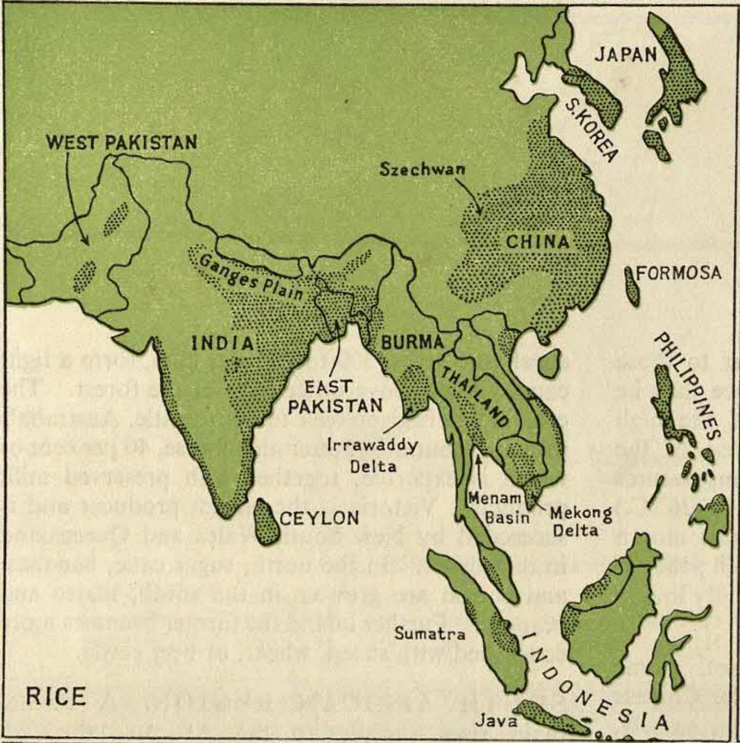
**THE AUSTRALIAN REGION.** This lies on the seaward side of the Eastern Highlands. Giant eucalyptus trees, 300 to 400 feet high, form a light canopy high above other trees of the forest. The coastal belt is given over to dairy cattle, Australia's principal source of butter and cheese, 40 per cent of which is exported, together with preserved milk products. Victoria is the largest producer and is succeeded by New South Wales and Queensland in that order. In the north, sugar cane, bananas, and cotton are grown; in the south, maize and oranges. Further inland the farmer becomes more concerned with sheep, wheat, or beef cattle.

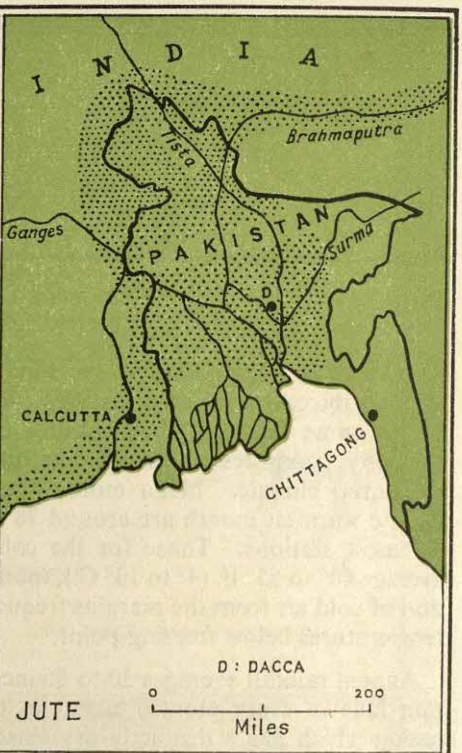
**SOUTH AFRICAN REGION.** A coastal plain rises sharply to the African tableland. Maize, known to the African as mealies, is favoured by the high temperatures and high humidity (p. 65). Special crops include the sugar cane and cotton of the plain, tea of the foothills, and timber of the higher slopes. The production of tea has been declining.

**SOUTH AMERICAN REGION.** This is the southernmost extension of the Brazilian highlands, politically a part of Brazil and Paraguay. It is noteworthy for the araucaria or Paraná pine and maté, one used for timber, the other for tea. Paraná pine provides 75 per cent of Brazil's timber export, shipped from Paranaguá, São Francisco, and the Paraná waterway. Coffee, cotton, and tobacco are other products.

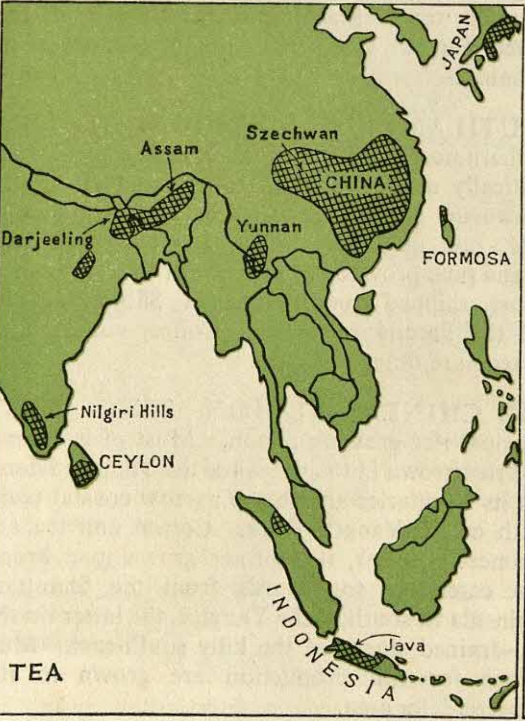
**THE CHINESE REGION.** This is China's principal rice-growing region. Most of it is lowland rice grown in the valleys of the Yangtze Kiang and its tributaries and in the narrow coastal plain south of the Yangtze delta. Cotton and tea are commercial crops, the former grown in a broad area extending southwards from the Shantung Peninsula to south of the Yangtze, the latter on the well-drained slopes of the hilly south-east. Mulberries for silk production are grown in the Yangtze delta area.

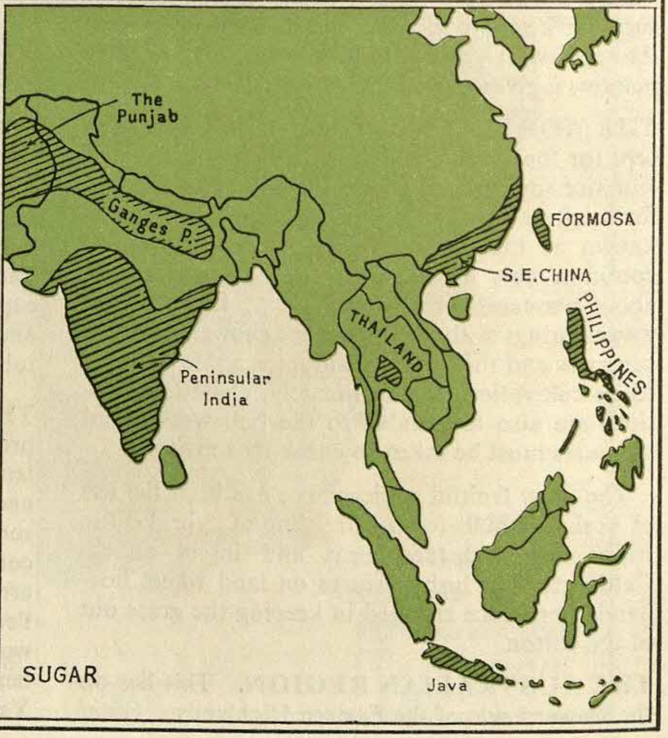
# Monsoon Lands



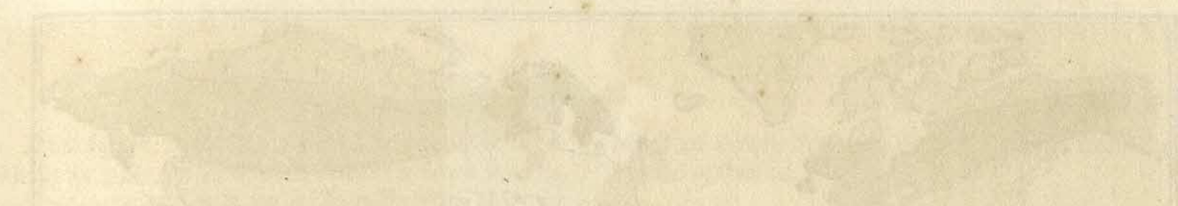


| BOMBAY Jan. to Dec. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. °F. | 76 | 76 | 80 | 83 | 86 | 84 | 81 | 81 | 81 | 82 | 81 | 77 | Total |
| Temp. °C. | 24 | 24 | 27 | 28 | 30 | 29 | 27 | 27 | 27 | 28 | 27 | 25 | |
| Rain (ins.) | 0·1 | 0 | 0·1 | 0 | 0·7 | 20·6 | 27·3 | 16 | 11·8 | 2·4 | 0·4 | 0 | 79 |





# Monsoon Lands



The monsoon climate resembles that of the tropical grassland in the alternation of wet and dry season (p. 37), though for different reasons (p. 29). Temperatures are similar but the wet season usually starts earlier (e.g. in May rather than in July) and the volume of rainfall is usually greater, though decreasing totals occur as the winds pass inland, e.g. Calcutta 64 in., Varanasi (Benares) 40 in., Delhi 27 in. High relief effects particularly heavy precipitation, giving the highest totals of any climatic region, e.g. Akyab in Burma, 204 in.

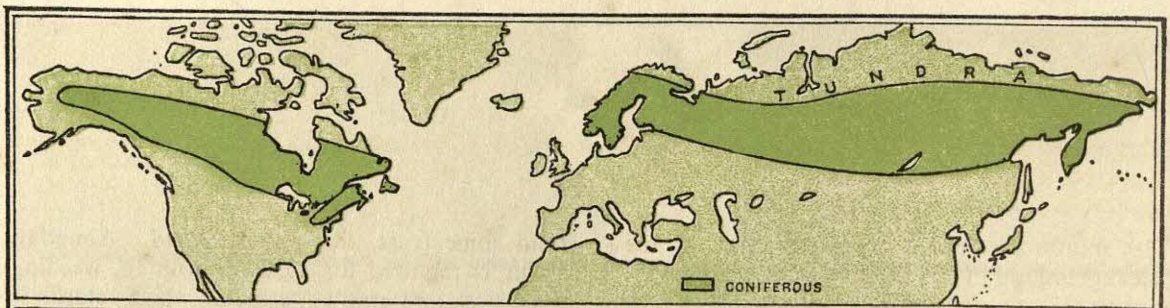
**Rice** is the most characteristic crop. In its natural state it grew in pools of water left behind when the Ganges floods subsided. It demands high mean temperatures, e.g. above 70° F. (21° C.) in the growing-season, and most critical of all, lots of water. A rainfall of between 45 and 65 inches is needed during the growing-season. Alluvial soils are best, hence its cultivation in the great river plains. 'Upland' rice is grown at higher elevations provided rains are heavy and not infrequent. About 93 per cent of world production comes from Asia. China leads with 35 per cent. This country has never been an active exporter or importer, but steps are being taken to develop an export trade. India, Pakistan, and Japan come next. Japan takes about one-third of the world exports, most of which comes from Burma, Thailand, and the Gulf Coast of the United States. Natural and economic conditions combine to affect yearly production of individual countries. Drought or excessive flooding are detrimental. Even so, world totals alter very little, but minor declines can be serious because of expanding Asiatic populations.

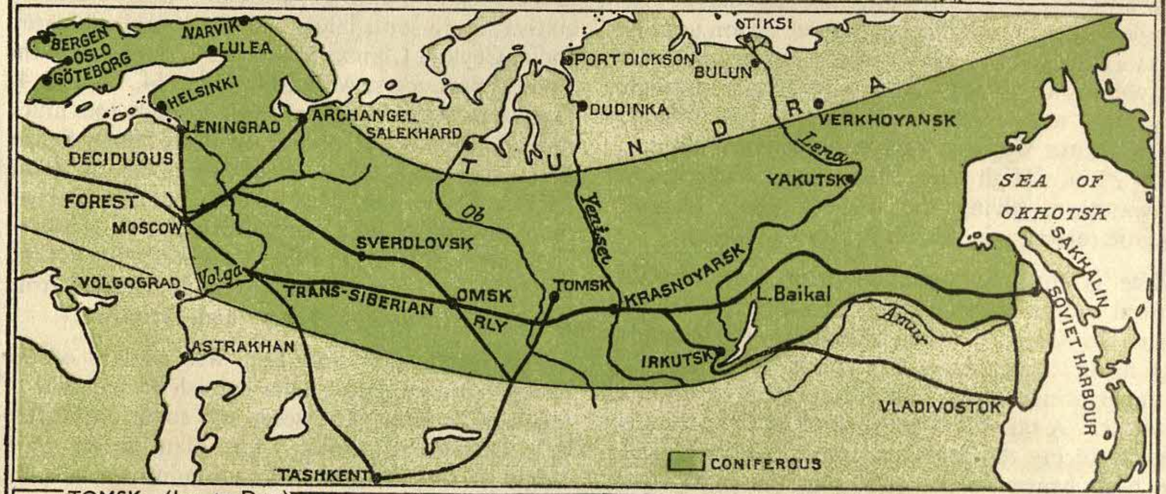
The monsoon lands are the chief sources of the world's **tea**. This shrub seems to have grown in the wild state on the steaming slopes of the Assam and Chinese hills, in soils rich in humus and sufficiently friable to permit good drainage without being washed away by summer downpours. Forty inches of rainfall will suffice providing it is evenly distributed, but 80 to 120 inches is better. A certain degree of acidity in the soils is beneficial. Since stagnant water favours fungoid growth, it is usually grown on hillsides, and while it can withstand some frost, this reduces yield. Abundant labour is required for picking, pruning, weeding, processing, and grading, a factor which retards its cultivation in some lands with favourable climates. India, Ceylon, China, Japan, and Indonesia are the leading producers, with 343, 212, 154, 78 and 42 thousand metric tons in 1962, though too much reliance should not be put on the Chinese figure. Expansion has taken place in northern India (Assam, Darjeeling, West Bengal), but this has been more than offset by a marked decrease in southern India (Nilgiri Hills) to effect a slight decline in total production. A rapid expansion is reported from Africa, particularly in Kenya and Tanzania.

The fertile soils and hot, wet climate of the Ganges–Brahmaputra delta furnish 95 per cent of the world's **jute**. The seeds are sown during the first showers of spring. The plant grows to a height of 10 to 14 feet in 4 to 6 months. It is cut between June and September when the plant is in flower, and steeped in water to loosen the fibre from the bark and inner woody core. The ryot can choose between rice, which he needs as food, or jute, the money from the sale of which he can use to buy rice. Consequently, the acreage under jute varies from one season to another, depending on the price he hopes to get for it, and the price he must pay for paddy. Jute is not damaged by floods, but high floods make harvesting difficult or impossible. Rice is ruined if it is submerged for more than five days. On the other hand, rice requires no manure, and since cow dung is scarce, rice may be his choice. Often he grows both, with the greater part of his 3 or 4 acres under rice. An allied fibre, requiring less wet conditions, is known as kenaf.

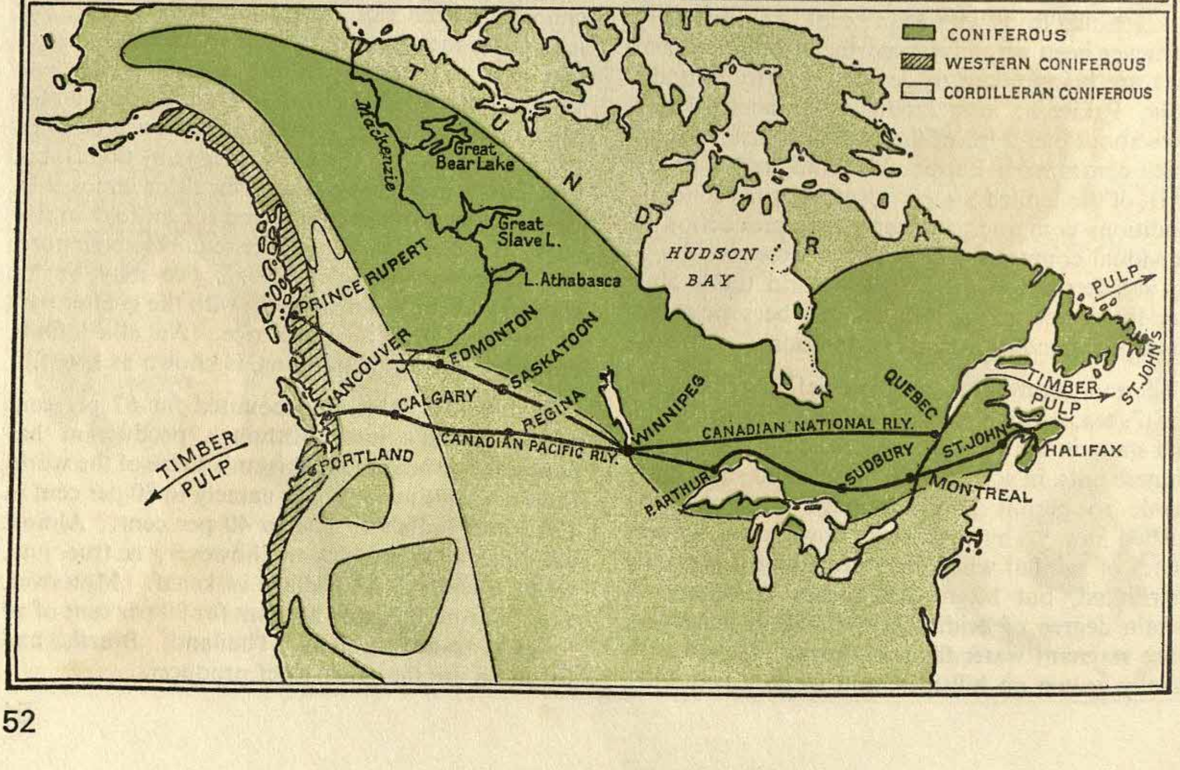
In 1946–50 Pakistan accounted for 67 per cent of the world's jute. Although production has continued to increase, Pakistan's share of the world total has continued to fall, namely to 30 per cent in 1962, and India's to rise to 40 per cent. Almost all Pakistan's production, however, is true jute, while one-third of India's is kenaf. Moreover, exports from Pakistan account for 90 per cent of all foreign trade in jute. Thailand, Brazil, and Formosa are the other chief producers.

# Temperate Forests





| TOMSK (Jan. to Dec.) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. °F. | −3 | 1 | 14 | 30 | 49 | 59 | 66 | 60 | 48 | 32 | 11 | 1 | |
| Temp. °C. | −19 | −17 | −10 | −1 | 9 | 15 | 19 | 16 | 9 | 0 | −12 | −17 | Total |
| Rain (ins.) | 1 | 2 | 0·75 | 0·75 | 1·5 | 2·75 | 3 | 2·25 | 1·5 | 2·5 | 1·5 | 2 | 21·5 |



# Temperate Forests

Taïga is the name given to the coniferous forest which extends across North America from Alaska to Newfoundland, and across Eurasia from Norway to Kamchatka.

**CLIMATE OF THE TAÏGA.** Climate is extreme because of high latitude and interior location. Winter is the dominant season, six to eight months long with mean temperatures around freezing-point. Some stations record several months with means below 0° F. (−18° C.). Summers are short and temperatures high. Annual ranges of 60° F. (33° C.) or more are common. Tomsk provides an example (p. 52). Yakutsk, near the 'pole of cold', has a January mean of −46° F. (−43° C.) and a July mean of 66° F. (19° C.). Precipitation rarely exceeds 20 inches. Most of it falls in summer.

**CHARACTERISTICS OF THE TAÏGA.** Conifers adapt themselves to climate in various ways. Needle-shaped leaves reduce transpiration, a thick cuticle prevents moisture in the leaf-cell from freezing, and the conical shape of the tree assists in shedding snow which might otherwise break the branches.

Fir and spruce are the chief species, with some pine and larch. Enclaves of deciduous birch and aspen occur. The density, size, and variety of species alter with latitude and likewise the commercial value. Northwards it deteriorates into tundra. Southwards it passes into steppe and in some instances into hardwood forest.

**OTHER CONIFEROUS FORESTS.** Although the coniferous forest corresponds fairly well with the taïga climate, there are important exceptions, notably the Pacific coast of North America, the Rocky Mountains, New England and the extreme south-east of the United States.

Again, conifers occur in the broadleaf forests of the eastern third of the United States, Manchuria and Korea, southern Chile, southern Brazil, coastal Natal, south-eastern Australia, Tasmania, and New Zealand.

**EXPLOITATION.** The temperate forest is the source of two-thirds of the world's timber and virtually all its wood-pulp. The Eurasian taïga provides both timber and wood-pulp. The North American taïga is used as a source of wood-pulp. Most of North America's timber comes from the Pacific seaboard.

Its exploitation is dependent on ease of access, transportation, and in many instances on the availability of hydro-electric power. Rivers are used for the floating of logs in eastern Canada, Sweden, and Finland, but not in British Columbia. Russian rivers end in the frozen Arctic, yet with the aid of icebreakers and aircraft, use is made of water transport during the brief summer. The Trans-Siberian railway, however, serves as the chief method of transport.

**ECONOMIC VALUE.** Forestry occupies an important place in the economy of Russia, Canada, the United States, Sweden, Norway, and Finland.

Russia has enough timber for her needs and is able to export. Archangel in the north and Volgograd in the south are sawmilling centres.

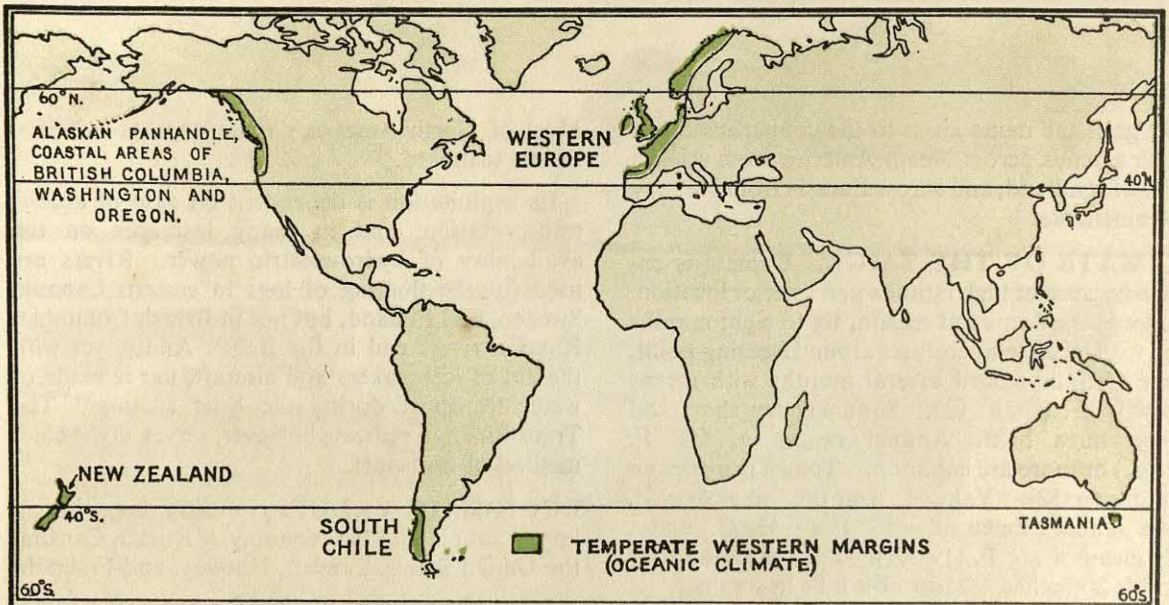
The United States supersedes Canada as a producer of timber, though not as an exporter. So great is the need for timber and pulp that on balance the United States is an importer.

Canada surpasses any other country as an exporter of forestry products. Newsprint, pulp, and timber constitute one-quarter of the total exports. Pulp and paper have a greater value than any other Canadian industry. Quebec and Ontario together account for 70 per cent of the newsprint. British Columbia with its valuable stands of Douglas fir accounts for 60 per cent of the timber. Fishing employs more people in Newfoundland than pulp and paper, but the latter has a higher value.

Forestry products are the leading exports of Sweden, Norway, and Finland. They constitute about one-quarter of Sweden's total and make Sweden the world's second largest exporter, though with a value about one-third that of Canada.

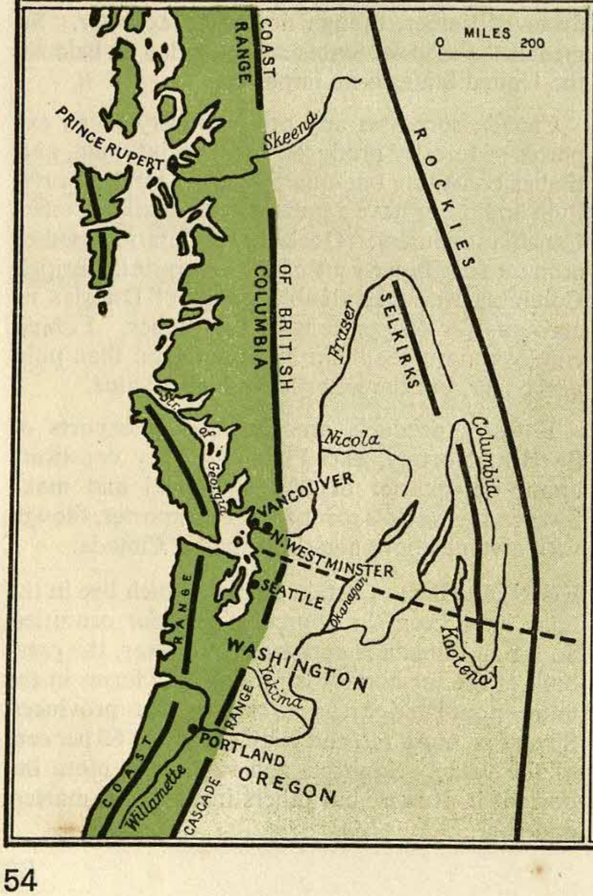
**FUR TRADE.** Certain animals which live in the taïga have been the source of furs for centuries. So far as Canada is concerned, however, the great bulk of the fur harvest is provided by farms in the more populated areas of all of the provinces. Silver fox, musk rat, and mink constitute 60 per cent of the value. Squirrels and sables are more important in Russia, but others include fox, marten, and bear.

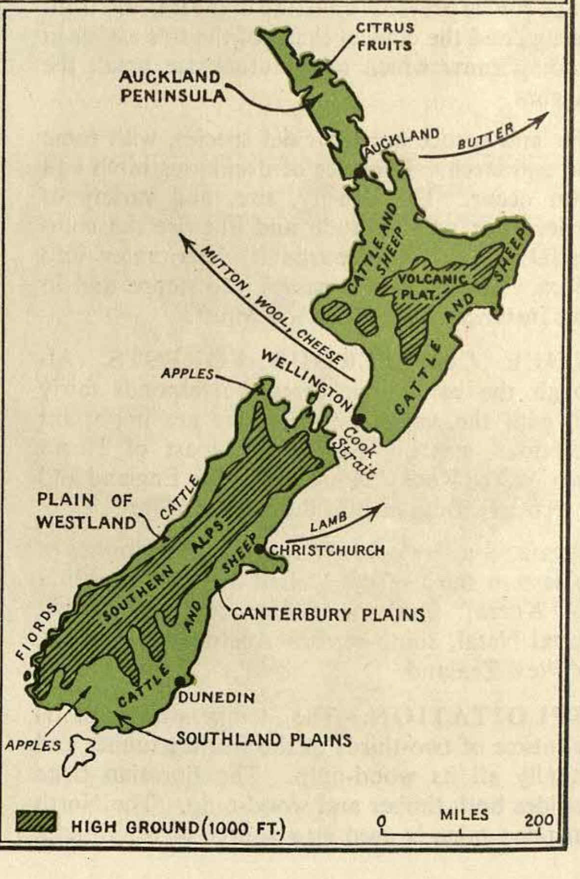
# Cool Temperate Western Margins


60° N.
ALASKAN PANHANDLE, COASTAL AREAS OF BRITISH COLUMBIA, WASHINGTON AND OREGON.
WESTERN EUROPE
40°N.
NEW ZEALAND
40°S.
SOUTH CHILE
TASMANIA
🟩 TEMPERATE WESTERN MARGINS (OCEANIC CLIMATE)
60°S.
60°S.

CHRISTCHURCH (NEW ZEALAND) Jan. to Dec.

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. °F. | 61 | 61 | 58 | 54 | 48 | 43 | 42 | 44 | 49 | 53 | 56 | 60 | |
| Temp. °C. | 16 | 16 | 14 | 12 | 9 | 6 | 6 | 7 | 9 | 12 | 13 | 16 | Total |
| Rain (ins.) | 2·2 | 1·8 | 1·9 | 1·8 | 2·8 | 2·6 | 2·6 | 2·1 | 2·1 | 2·0 | 1·8 | 2·5 | 26 |





# Cool Temperate Western Margins

**CLIMATE.** Western sides of continents lying between 40° to 60° latitude receive westerly winds throughout the year (p. 28). The ocean prevents temperatures from becoming extreme and the prevailing winds bring ample precipitation in all months, with a maximum in autumn or winter. Summers are cool and damp; winters are mild and wet. Frosts occur, but they are rarely of prolonged duration.

Nevertheless considerable differences exist. Where high mountain ranges lie athwart the course of the winds, rainfall is unusually heavy, as instanced by more than 100 inches in Norway, southern Chile, the South Island of New Zealand, and the North American coastline from Oregon to Alaska. Areas in the rain-shadow are comparatively dry. Milford Sound in New Zealand receives over 250 inches, Christchurch only 27 inches. Apart from Norway, Western Europe has few mountain barriers, so that rainfall totals are usually lower, and the flow of maritime air makes a more effective entry. Even so, the English Lake District records over 100 inches, while East Anglia receives only 25 inches. No figure, therefore, can be regarded as typical.

Mean annual temperatures are mostly in the range 45° to 55° F. (7° to 13° C.), unless modified by altitude. The mean monthly temperature of the warmest month is usually 60° to 65° F. (16° to 18° C.). Annual range of temperature is small, e.g. Valencia 15° F. (8° C.); Hobart 16° F. (9° C.); and Seattle 24° F. (13° C.).

**WESTERN EUROPE.** The economy of Western Europe differs from that of the others in being more concerned with manufacturing industry than agriculture or forestry. The production of textiles, iron and steel, machinery, motor transport, aircraft, ships, and chemicals supports dense populations in Great Britain, France, the Low Countries, and Western Germany. Nevertheless, agriculture is strongly represented. Dairying, for instance, is of considerable importance in Denmark, the Netherlands and the Irish Republic; wheat and other cereals are grown in eastern England, the Paris Basin and other localities; and temperate fruits thrive in all parts. Fishing has a place in the economy of all the countries, and forestry in that of Norway.

**NORTH AMERICA.** The North American region is largely concerned with forestry and fishing, and in British Columbia with mining also. Considerable use is made of hydro-electric power. Fruit is a product of the Okanagan, Nicola and Kootenay Valleys of British Columbia and the Yakima Valley of Washington. The region is thinly peopled, therefore, and populations tend to congregate in nodes. Three-quarters of British Columbia's population is to be found within a 90-mile radius of Vancouver. On the other side of the border, the chief centres occur either on Puget Sound, with Seattle the largest of all, or on the Columbia River, as instanced by Portland.

**SOUTHERN CHILE.** Southern Chile contributes little to the economy of the country. It is too mountainous and wet for agriculture. Little timber is cut because of its poor quality and long distance from world markets.

**NEW ZEALAND.** New Zealand is a prosperous agricultural region. The economy is overwhelmingly geared to grassland farming, whose products constitute nearly 90 per cent of the exports — principally wool, lamb, beef, butter, cheese and hides. Even so, two-thirds of the population live in urban areas, the largest of which are Auckland, Wellington, Christchurch and Dunedin.

**TASMANIA.** Tasmania has a varied economy. Not only is she able to export apples, wool, and timber, but also refined copper and zinc, for which use is made of hydro-electric power. Hobart is the main urban centre.

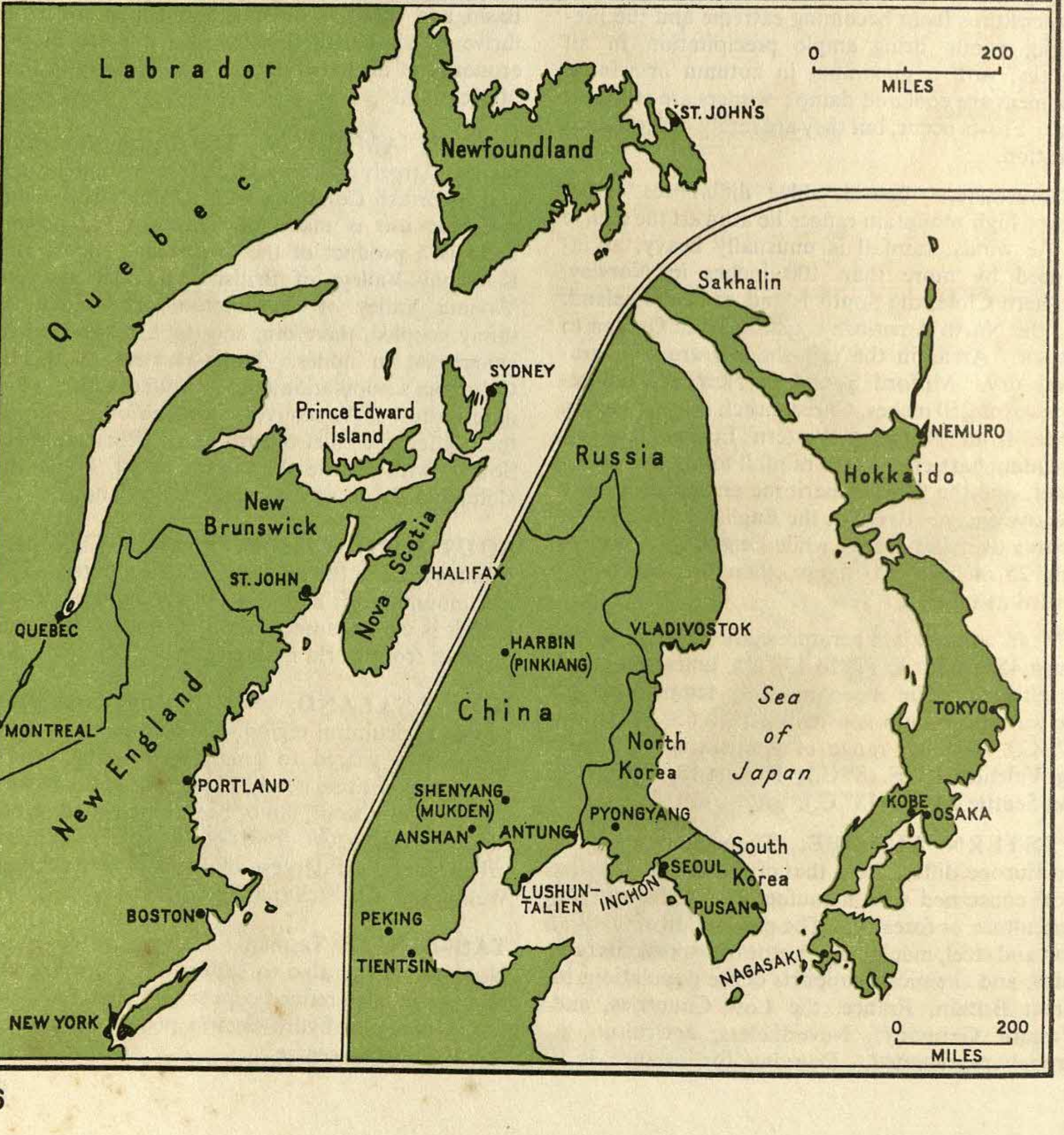
# Temperate Eastern Margins

BOSTON (NEW ENGLAND) Jan. to Dec.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. °F. | 27 | 28 | 35 | 45 | 57 | 67 | 71 | 69 | 63 | 52 | 41 | 32 | |
| Temp. °C. | −3 | −2 | 2 | 7 | 14 | 19 | 22 | 21 | 17 | 11 | 5 | 0 | Total |
| Rain (ins.) | 3·7 | 3·5 | 4·1 | 3·8 | 3·7 | 3·1 | 3·5 | 4·2 | 3·4 | 4·1 | 4·1 | 3·8 | 45 |

INCHON (SOUTH KOREA) Jan. to Dec.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. °F. | 25 | 28 | 37 | 49 | 59 | 67 | 74 | 77 | 68 | 57 | 43 | 30 | |
| Temp. °C. | −4 | −2 | 3 | 9 | 15 | 19 | 23 | 25 | 20 | 14 | 6 | −1 | Total |
| Rain (ins.) | 0·8 | 0·7 | 1·2 | 2·6 | 3·3 | 3·9 | 10·9 | 8·8 | 4·3 | 1·6 | 1·6 | 1·1 | 41 |



# Temperate Eastern Margins

**CLIMATE.** The two regions show similarity in their wide range of annual temperature, e.g. Inchon in Korea, 52° F. (29° C.), Nemuro in Hokkaido, 41° F. (23° C.), and Portland in Maine, 46° F. (25° C.). They differ, however, in the distribution of their rainfall. The American region receives rainfall throughout the year, and while this is also true of Japanese stations, the Asiatic mainland has a dry season. Southern Japan also benefits from the ameliorating effect of the sea. Thus although Tokyo has an annual temperature range of 41° F. (23° C.), January temperatures are never so low as those of mainland stations.

**VEGETATION.** The natural vegetation of the American region is that of a broadleaf and mixed broadleaf–coniferous forest, though little trace remains today. Its extent in the Asiatic region can only be determined by inference. Certainly much of the area is grassland.

**NORTH AMERICAN REGION** (Newfoundland, Atlantic Provinces, New England). The region lies in the zone of conflict between continental and maritime air, with continental air more frequently in possession. The track of cyclonic movement in winter lies across the south of it and promotes cold and wet conditions everywhere. The sea exerts little influence, except to maintain icefree harbours. January temperatures at Portland fall to 18° F. (−8° C.).

In summer the cyclonic track is further north. Inblowing air from the sea raises midsummer temperatures in Nova Scotia to 60° F. (16° C.), though the arrival of summer is frequently delayed by cold north-western air from the ice floes. In New England, July means are higher, e.g. Boston (p. 56).

The cool climate, short growing-season and abundant rainfall (35 to 55 inches) are not conducive to arable farming, and with the exception of a few favoured localities, the region is more suited to hay and oats. Consequently most farmers engage in some form of livestock farming. In some areas, such as New Brunswick, lumbering takes precedence over agriculture. All coastal areas engage in fishing. New England's main concern, however, lies in manufacturing industry. It is, in fact, the eastern end of the great manufacturing belt of the United States which crosses the Appalachians from the Middle West.

**THE ASIATIC REGION** (North China, the Koreas, Japan). Outblowing winds from the high-pressure area centred over Siberia account for the dry cold winters of the mainland and its icebound coasts. Vladivostok has a January mean of 7° F. (−14° C.). In passing over the Sea of Japan, winds acquire water vapour, and bring rain to Japan.

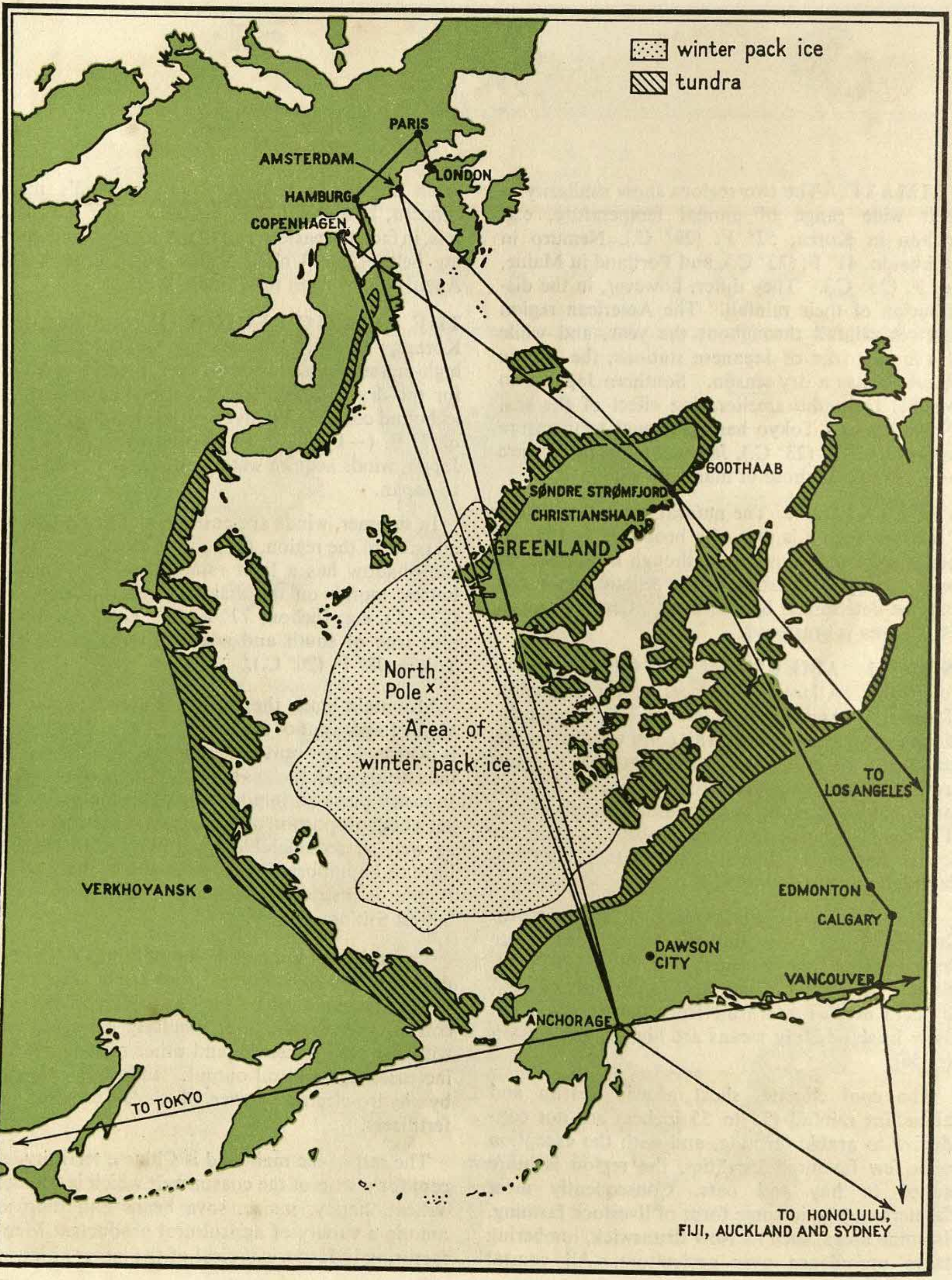
In summer, winds are onshore and bring rain to all parts of the region, though western Japan in the rain-shadow has a light rainfall. Means for the hottest month on the mainland approach 80° F. (27° C.), e.g. Inchon, 77° F. (25° C.), and this is also true of south and south-eastern Japan, e.g. Tokyo, 78° F. (26° C.).

Mountain limits the cultivable area in Japan to about 16 per cent of the total. Of this, 55 per cent is in rice, 40 per cent in field crops, and the rest in industrial crops, such as mulberry, tea, and tobacco. Industry plays an important part in the economy, yet a high proportion of the necessary raw materials, as well as considerable quantities of foodstuffs, have to be imported. Japan is one of the world's leading industrial nations, and is also the world's largest fishing country.

Two-thirds of the population of South Korea are dependent on agriculture. Rice is the chief crop, though there are others such as barley, wheat, and cotton. North Korea is similarly engaged, and with the aid of tractors and other machinery, has increased agricultural output. Industries, assisted by hydro-electric power, include textiles and fertilizers.

The rest of the mainland is Chinese territory, except for a strip of the coastal belt which is Russian. Wheat, barley, maize, soya beans and tung are among a variety of agricultural products. Manufacturing industry is typical of the larger cities.

# The Tundra


winter pack ice
tundra
PARIS
AMSTERDAM
LONDON
HAMBURG
COPENHAGEN
GODTHAAB
SØNDRE STRØMFJORD
CHRISTIANSHAAB
GREENLAND
North Pole
Area of winter pack ice
TO LOS ANGELES
VERKHOYANSK
EDMONTON
CALGARY
DAWSON CITY
VANCOUVER
ANCHORAGE
TO TOKYO
TO HONOLULU, FIJI, AUCKLAND AND SYDNEY

# The Tundra

The tundra lies to the north of the taïga.

**CLIMATE.** Climate is substantially like that of the taïga, except that summer temperatures are not so high and precipitation, mostly in the form of snow, is less than 15 inches. Average temperatures for the warmest month are below 50° F. (10° C.). For long periods ice covers the Arctic Ocean and renders it less effective as a moderating influence than oceans in lower latitudes. Even by late summer a vast ice floe remains, as large as the United States, with its centre, the 'pole of inaccessibility', some 400 miles from the North Pole in the direction of the Bering Strait.

**VEGETATION.** Low temperatures and permanently frozen subsoil preclude the growth of anything but the lowest form of plants, such as mosses, lichens, and sedges, and the occasional dwarf birch or aspen. Considerable areas are devoid of vegetation, and the alternating thawing and freezing of surface soil produces a pattern of hummocks enclosing depressions which become filled with water in summer. Millions of mosquitoes breed in them.

**AGRICULTURE.** Agriculture is restricted by climate and topography to a few favourable tracts, and is carried out only at a relatively high cost of production. The market is purely local and its existence depends upon the presence of strong sources of non-agricultural purchasing-power.

**MINERAL WEALTH.** This attracts some settlement. The Norwegians long ago made use of Svalbard (Spitsbergen) deposits of coal. The Russians make use of the Pechora and Tungusk fields. A diamond field in Yakutia is of immense value to Russian industry. Natural gas has been discovered in Yakutia and on the shores of the Okhotsk Sea.

Coal is worked in the Alaskan tundra near Fairbanks and in the Bering Valley. Oil is a product of the Fort Norman area and the Kenai Peninsula. Natural gas has been confirmed south of Barrow and in several other places, but the local market is small and world markets a long way away.

Metalliferous ores include the uranium of Great Bear Lake, the gold of the Great Slave Lake, and the nickel–copper of Rankin Inlet. The most significant find of all is the vast deposits of iron ore on the Labrador–Quebec border. Burnt Creek, now renamed Schefferville, was the first settlement, and is now only one of a number of prosperous cities, such as Wabush and Labrador City. Mile-long trains carry the ore to Sept Îles on the St. Lawrence.

The **strategic value** of the tundra, so far as North America is concerned, is to be seen in the high military spending of the United States. With the co-operation of Canada and Denmark, a Distant Early Warning system (DEW) is in operation. A string of radar stations, strung across the continent from Alaska to Greenland, gives early approach of hostile aircraft or missiles.

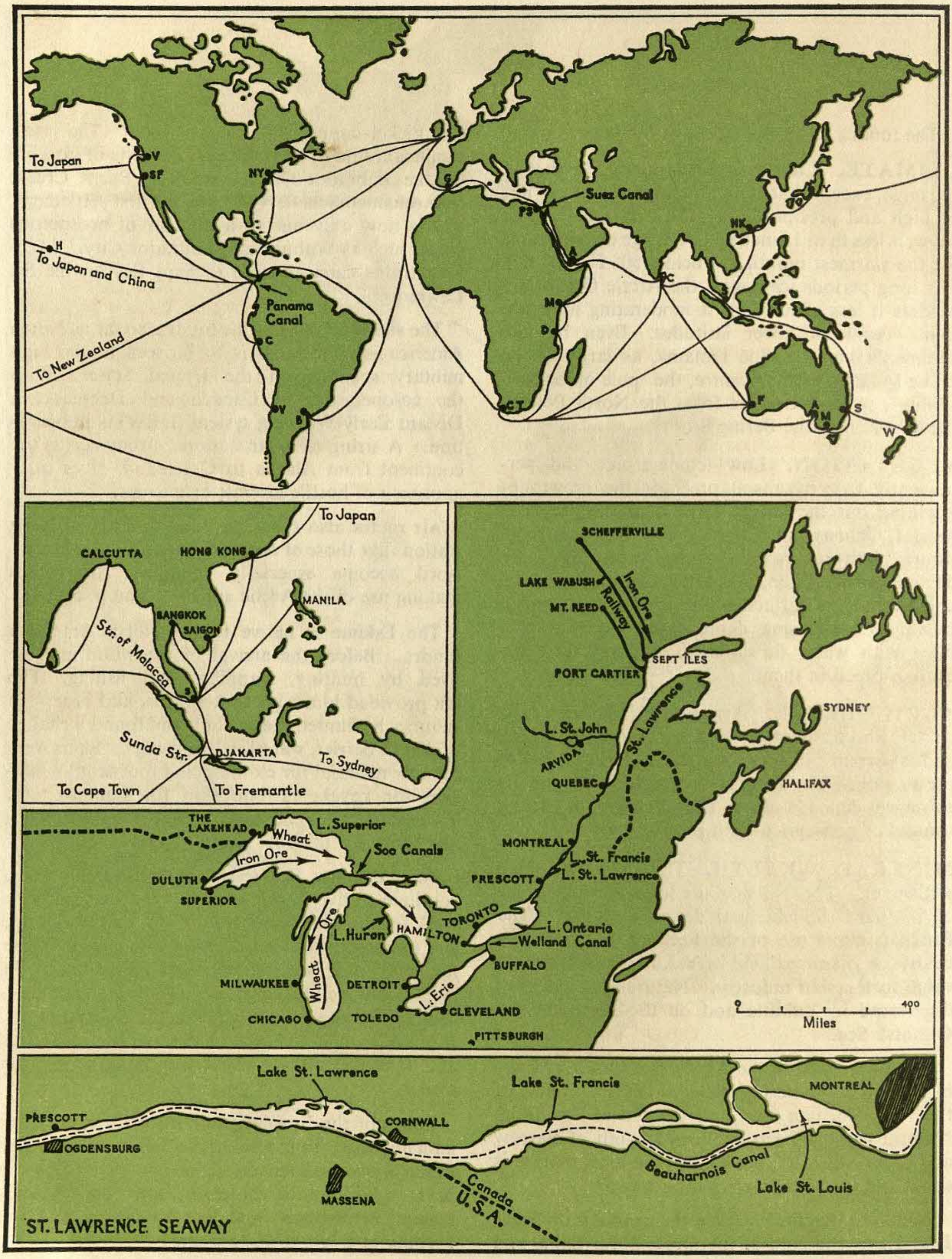
**Air routes** also cross the tundra, and refuelling stations like those of Anchorage and Søndre Strømfjord become especially valuable. Air routes making use of the Arctic are shown on p. 58.

The **Eskimo** is native to the North American tundra. Before the arrival of the white man he lived by hunting, trapping, and fishing. The sea provided him with seal, walrus, and bear. In summer he hunted the caribou and found a change of diet in berries, waterfowl, and eggs. Skins were the raw material for clothing and footwear — sealskin for kayak, caribou skin for summer tent. There was fat for the lamp, bone for the arrow tip, and sinew for thread.

Some Eskimos, isolated in the Arctic archipelago, continue to live in this way, but the vast majority work for the white man — in mines, on the airstrip, and in defence stations. Those who engage in the fur trade now use the rifle and motor-boat. In Alaska and the Mackenzie delta some tend reindeer. This animal was introduced from the Asiatic tundra. It provides milk and meat, hides and bones, antlers and tendons, all of which can be used by the owner.

**Lapps** of the European tundra still pursue their nomadic life, following their herds of reindeer which move instinctively from one pasture to the next. Many more, however, now occupy permanent settlements, and live by fishing and the keeping of a few cows and hens.

# Seaways


To Japan
V
SF
NY
H
To Japan and China
Panama Canal
C
To New Zealand
V
B
G
Suez Canal
PS
A
M
D
CT
C
HK
Y
S
F
A
M
S
W
A
To Japan
CALCUTTA
HONG KONG
MANILA
BANGKOK
SAIGON
Str. of Malacca
S
Sunda Str.
DJAKARTA
To Sydney
To Cape Town
To Fremantle
SCHEFFERVILLE
LAKE WABUSH
MT. REED
Iron Ore Railway
SEPT ILES
PORT CARTIER
SYDNEY
L. St. John
ARVIDA
St. Lawrence
QUEBEC
HALIFAX
THE LAKEHEAD
Wheat
L. Superior
Iron Ore
Soo Canals
DULUTH
SUPERIOR
MONTREAL
L. St. Francis
L. St. Lawrence
PRESCOTT
Ore
L. Huron
HAMILTON
TORONTO
L. Ontario
Welland Canal
BUFFALO
Wheat
MILWAUKEE
DETROIT
L. Erie
CHICAGO
TOLEDO
CLEVELAND
PITTSBURGH
0
400
Miles
Lake St. Lawrence
Lake St. Francis
MONTREAL
PRESCOTT
OGDENSBURG
CORNWALL
Beauharnois Canal
Lake St. Louis
MASSENA
Canada
U.S.A.
ST. LAWRENCE SEAWAY

# Seaways

**North Atlantic Sea Lanes** between North America and Europe carry the greatest volume of traffic. Both continents are highly industrialized so that there is a considerable interchange of manufactured goods. Eastbound traffic also includes the transport of raw materials, such as grain, timber, meat, ores, and cotton. There is a big passenger traffic.

The **St. Lawrence Seaway** is the name given to the section of the St. Lawrence river between Prescott and Cornwall which was opened in 1959 for the production of hydro-electricity and the provision of low-cost water-transport. Prior to this, ocean vessels could travel 1,000 miles up to Montreal, and 25,000-ton 'lakers' could steam eastward from the head of Lake Superior for another 1,000 miles, but the 125-mile-long stretch in between was virtually unnavigable. Bulk cargo, such as grain, iron ore, coal, pulp, and petroleum, is the chief beneficiary, e.g. iron ore from Labrador to the furnaces of the lake shores (Hamilton, Buffalo, Cleveland, Detroit, Chicago) and Pittsburgh; wheat from the Lakehead (Fort William–Port Arthur) to Montreal and Quebec; coal from Pittsburgh to Montreal. 'Salties', crossing the high seas, can also reach the lake ports, including those of Toronto, Toledo, and Milwaukee as well as the ports already mentioned.

Other **Atlantic Routes** of great importance are those from South America to North America and Europe. Coffee, cocoa, and meat are exported from Brazil, and meat, wheat, wool, hides, and maize from the Plate; manufactured goods move in the reverse direction.

The **Suez Route** provides numerous refuelling depots — Gibraltar, Port Said, Aden, Colombo, Singapore — and ports of call where return cargoes can be taken on board. Commodities reaching Europe include (*a*) coffee, cloves, and sisal from East Africa, (*b*) petroleum, dates, and hides from the Persian Gulf, (*c*) jute, cotton, tea, wheat, and groundnuts from India and Pakistan, (*d*) sugar, coffee, copra, and petroleum from the East Indies, (*e*) silk, tea, beans, and vegetable oils from the Far East, (*f*) tobacco, sugar, and hemp from the Philippines, and (*g*) wool, meat, butter, and wheat from Australia and New Zealand. The Suez Canal reduces the distance from India to Britain by 4,000 miles, from the Far East by 3,000 to 3,500 and from Australia by 1,200. It is also shorter than the Panama from North American Atlantic ports to India and southern China, but not to Japan and Australia.

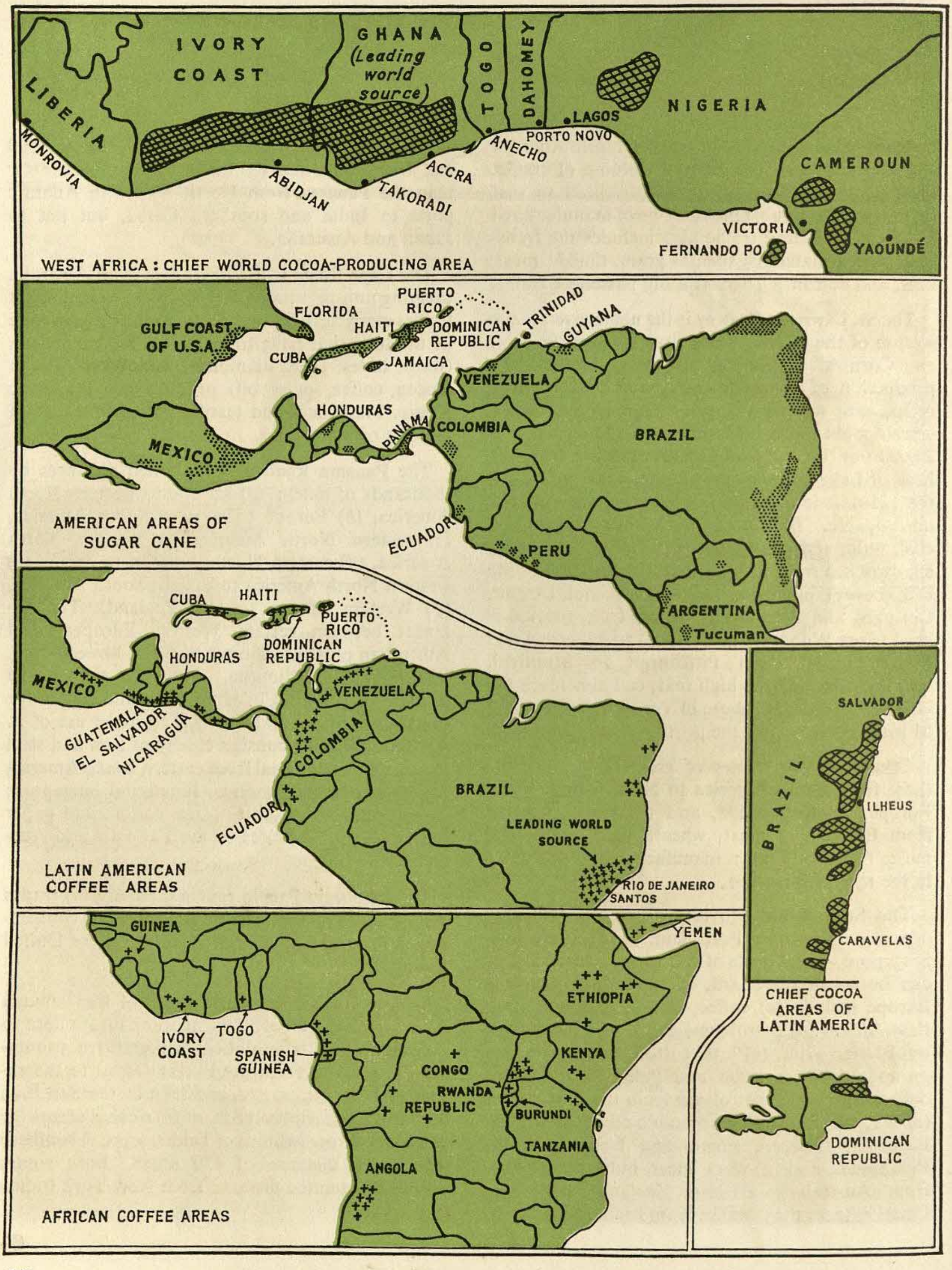
The **Cape Route** is used by boats from Australia carrying non-perishable cargoes, but it is significant that as many vessels use the Suez as the Cape in spite of the tolls that have to be paid. South African (wool, hides, fruit, diamonds) and West African (cocoa, coffee, palm oil) produce use the Cape Route. Machinery and textiles comprise the main imports of these areas.

The **Panama Route** has shortened distances by thousands of miles: (*a*) Europe to western North America, (*b*) Europe to western South America, (*c*) eastern North America to western North America, (*d*) eastern North America to Japan, (*e*) western North America to eastern South America, (*f*) Western Europe to New Zealand. The distances between certain Western European and Australian ports are shorter by Suez, however, e.g. Liverpool to Melbourne. Canadian timber and salmon for Britain, Chilean nitrates and copper for the United States and Europe, all make use of it. Westbound traffic consists chiefly of iron and steel manufactures and coal from eastern North America to western North America, Japan and Singapore; petroleum, scrap iron, tinplate, cotton, and paper from the United States to the Far East and Australia.

Of the purely Pacific routes there are (*a*) routes calling at Honolulu, (*b*) the northerly route connecting Japan and China with Canada and the United States.

In view of the great use made of the Panama Canal, it may be necessary at some future date to consider other possibilities: either (*a*) a twenty-mile long canal from the Pacific Ocean to the extensive Lake Nicaragua, and then by the San Juan River to the Caribbean Sea, or (*b*) a canal across the low and narrow Isthmus of Tehuantepec in southern Mexico, a distance of 150 miles. Both routes would shorten the distance from New York to San Francisco.

# Cultivated Crops—I



There are many examples of successful transplanting.

**Rubber** was taken from the Amazon to south-east Asia. An equable temperature (75° to 95° F. or 24° to 35° C.) and a high rainfall (70 to 75 inches) are needed and a deep well-drained soil. Malaysia accounts for about 36 and Indonesia for 31 per cent of world production. Most of the rest comes from other Asian countries, notably Thailand, Ceylon, Vietnam, and Cambodia. African production comes mainly from Nigeria, Liberia, and the Congo.

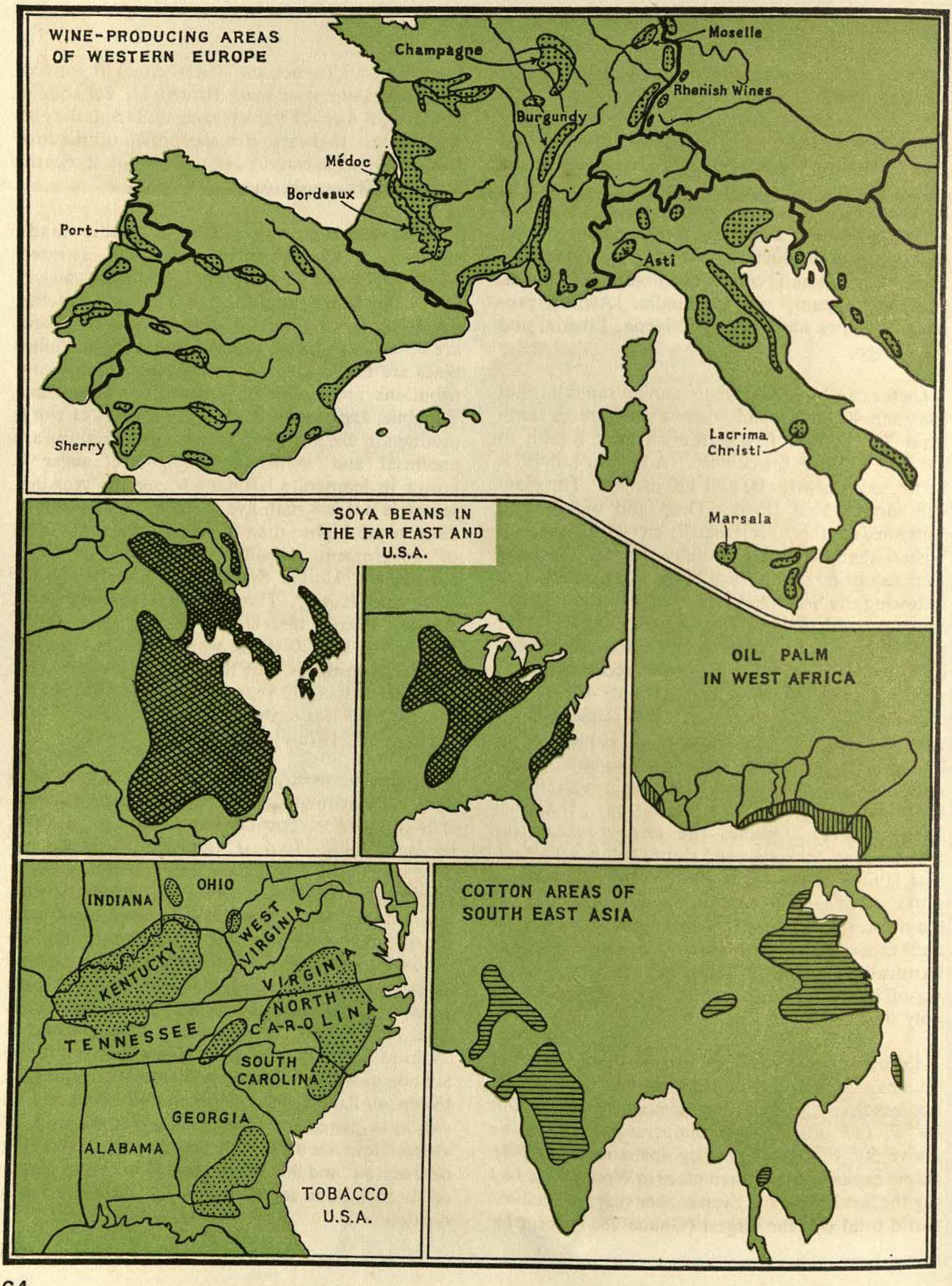
**Coffee** can be grown where annual rainfall is not less than 40 inches and where temperatures range from 70° F. (21° C.) in the warmest month to 63° F. (17° C.) in the coldest. A heavier rainfall is better, say, between 60 and 120 inches. The plant will survive light frosts. Deep and well-drained soils are desirable. It is usually grown at elevations higher than sea-level, usually several thousand feet according to latitude. Brazilian production following the Second World War was about 50 per cent of world production. Brazil's share in 1962 was 42 per cent. Expansion goes on elsewhere, notably in Colombia, which now accounts for 11 per cent. Middle America accounts for 11 per cent and Africa 27 per cent. For some, it is the principal export, e.g. Guatemala, Honduras, El Salvador, Ivory Coast, Uganda, Ethiopia. Latin-American policy has been to maintain high prices: this has fostered African expansion. The chief Brazilian area occupies the terra roxa of the plateau edge, on ridges and slopes below 3,000 feet. The United States takes 40 per cent of world exports. Coffee consumption has been rising in the main consuming countries during the last 25 years, and especially in the traditional tea-consumers (Australia, Canada, Britain), but because of a falling-off in the Near East, world totals have increased only slightly.

**Cocoa** is indigenous to islands in the Gulf of Guinea. It needs a moister climate than coffee, not less than 45 inches, and temperatures of about 80° F. (27° C.). Night temperatures should be above 50° F. (10° C.). Dry spells reduce yields. Rapid expansion has taken place in West Africa during the last 20 years. Even so, her share of the 1962 world total was the largest (Ghana 28, Nigeria 15, Ivory Coast 9, Cameroun 7), now equal to pre-war. The Latin-American share (Brazil 17, Ecuador 4, Dominican Republic 3) has increased from the pre-war figure. In Brazil cocoa is grown on the lowlands south of Salvador, and this locality shows the largest American increase.

**Sugar cane** is grown on damp tropical lowlands, especially on alluvial soils near the sea. It rarely does well where temperatures fall below 60° F. (16° C.). If the rainfall is less than 50 inches, irrigation is necessary. Moisture-retaining soils are beneficial. Cuba, Brazil, India, and the Philippines are the leading producers, and notable contributions are made by Mexico, the Dominican Republic, and Puerto Rico. Percentages of world production are not given because some returns are unofficial and some unreliable. **Beet sugar** is grown in temperate latitudes where the growing-season is not less than five months. Costs of production are higher than for cane, and some form of government subsidy is usually necessary. Russia, the United States, and France are the leading producers. Those for total sugar are Cuba, Russia, Brazil, the United States, and India. During the last 20 years, world consumption has risen by two-thirds, but the balance between beet and cane shifts from year to year. World production for 1963 was estimated at 441mill. metric tons for cane and 167mill. for beet.

Henequen, sisal, and abaca are known as **hard fibres**. Henequen is a member of the agave family. It is confined to Yucatán and is used in Mexican cordage mills. Sisal is transplanted henequen. Like henequen, it is grown as a perennial crop in dry tropical climates — Tanzania, where it forms the leading export, Kenya, Cuba, north-east Brazil. It forms two-thirds of total world production. This has been constantly rising, the increased output of East Africa, Brazil, and Malagasy outweighing the decline in Indonesia and West Africa. Abaca or manila needs a moister climate and is confined to the Philippines. **Hemp** is grown in the humid areas of temperate latitudes, especially European Russia, the Danubian and Po Basins, as well as in Korea and China. A growing-season of at least four months, with temperatures averaging between 60° and 80° F. (16° and 27° C.) and plenty of cheap labour are necessary for successful production.

# Cultivated Crops—II



# Cultivated Crops—II

**Maize**, known in North America as corn, needs a growing-season of five months, a warm summer, day and night, and a deep soil. Different varieties have different needs, but optimum conditions appear to be served by a mean summer temperature of 75° F. (24° C.) and an annual rainfall of between 25 and 40 inches. Favourable conditions of the American Middle West (p. 48) make the United States the leading producer with over 42 per cent of world production. Russia, China, Brazil, Mexico, South Africa, Yugoslavia, and Roumania come next. Increases are recorded by all of these countries.

**Cotton** production (p. 49) continues to increase because (*a*) there has been a tendency for all producers except the United States to expand because of nationalist aims; (*b*) though acreage has been restricted in the United States, yields have been higher. The leading countries with percentages of 1962 production are the United States (29), China (22), Russia (13), India (9), Brazil (6), and Mexico (5). Increased output in recent years comes mainly from India, the U.A.R., the Sudan, and Turkey. In the last decade India has supplied 45 per cent of all cotton grown outside the United States and the communist countries.

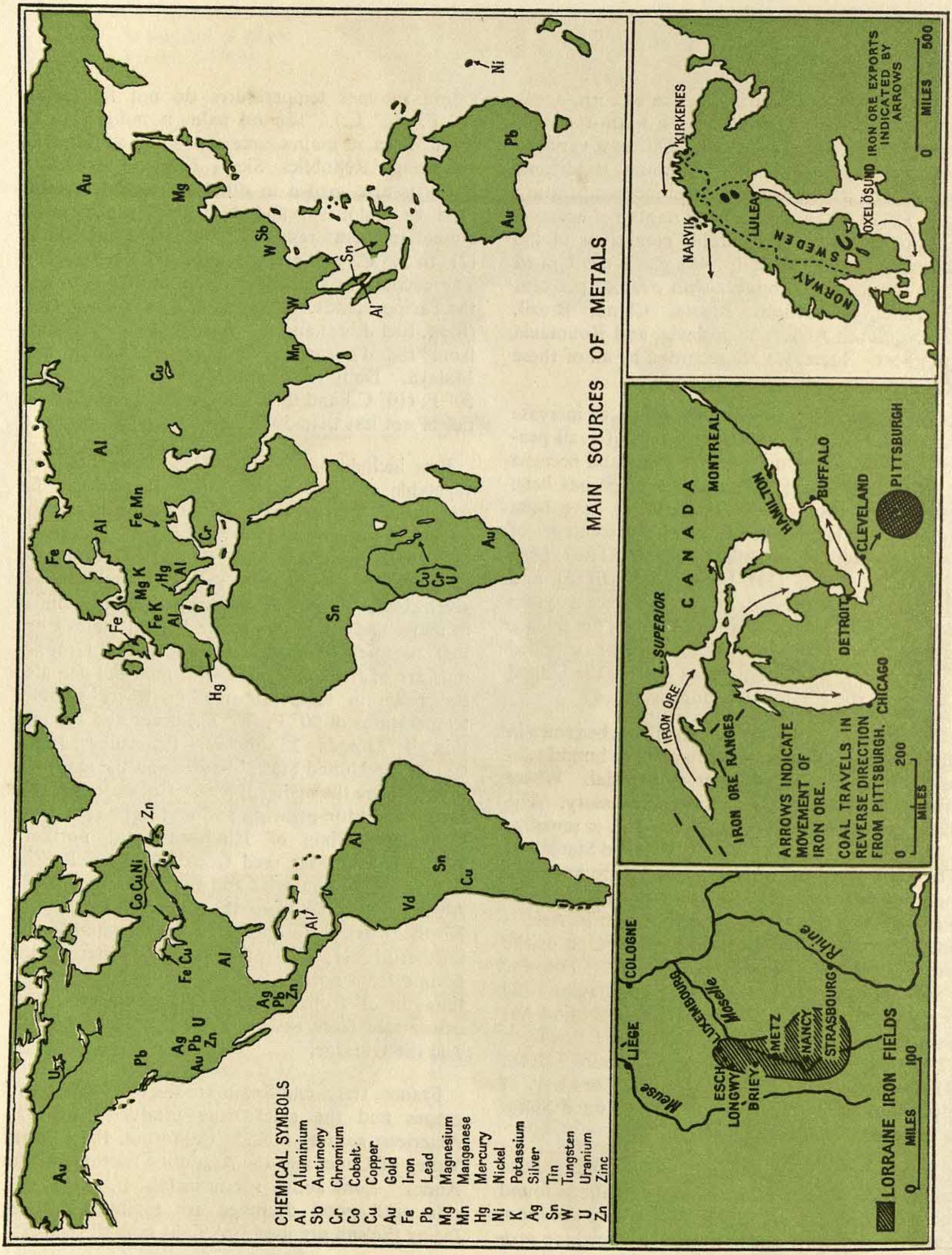
**Tobacco** is native to America. It can be grown in climates ranging from dry temperate to humid subtropical, but plenty of water is essential. Where rainfall is insufficient, irrigation is necessary. The plant has a short growing-season and is sensitive to frost. The eastern part of the United States and China are the chief producers, but there has been a change in geographical distribution since the pre-war period. The total quantity grown in Asia is about the same, but the Asian percentage of the world total has fallen from 49 to 42. The Far Eastern share (China, Japan, Korea) remains at 23 per cent, and although Turkey's contribution has risen from 2·7 to 3·9, that of India has fallen from 12 to 8. African production, mainly from Rhodesia, is three times higher than pre-war, at 5 per cent of the world total. The United States is the world's largest exporter.

**Palms** include the date, oil, and coconut. Date palms need the sunshine and dry conditions found in Iraq, Arabia, Iran, North Africa, and Pakistan, but can be grown under irrigation elsewhere providing summer temperatures do not fall below 60° F. (16° C.). The oil palm is indigenous to West Africa, its main source of production (Nigeria, the Congo Republics, Sierra Leone, Cameroun), but it is also grown in other equatorial regions, such as Indonesia and Malaysia, where mean annual temperatures lie between 70° and 80° F. (21° to 27° C.) and where rainfall is over 40 inches. The coconut is a product of south-east Asia and the Pacific islands. It serves as a subsistence crop (food, fuel, fibre) and is exported as copra, mainly from the Philippines, Indonesia, Ceylon, and Malaya. Daily temperatures must not fall below 50° F. (10° C.) and there should be an annual rainfall of not less than 50 inches.

**Fats** include animal fats (lard, butter, tallow), vegetable oils and marine oils. In terms of fat equivalent, the first provided 43 per cent, and the second 54 per cent, of 1960 production. Vegetable oils include palm, soya bean, groundnut, cottonseed and other oils. The main sources of palm oil are given above. Soya beans require conditions similar to maize and are grown in the United States Corn Belt, north-east China, and the Koreas. Groundnuts are of tropical American origin, but can also be grown in temperate regions where summer temperatures of 80° F. (27° C.) occur and summer rainfall exceeds 25 inches. Peninsular India, China, the United States' South, and the savannas of Africa are the main sources. Cottonseed comes from the cotton-growing regions; rape seed from China, the Plain of Hindustan and northern Europe; sunflower seed from European Russia, the Danubian countries and the pampas of South America; linseed from the spring-wheat belt of North America, European Russia, the pampas and northern India; olive oil from the Mediterranean; sesame from north China, India, and the Sudan; tung-nut oil from China and the Caucasus; and castor seed from eastern Brazil, peninsular India, and the Ukraine.

France, Italy, and Spain are the chief sources of **grapes** and the chief wine producers (p. 47). American sources include California, the Central Valley of Chile, and the Argentine foothills of the Andes. Long sunny summers (60° F. or 16° C.), rain, and good drainage are essential. Slopes facing the sun are used. A light rainfall suffices.

# Distribution of Metals



MAIN SOURCES OF METALS

# Distribution of Metals

Metallic ores are so widely distributed that only the chief sources can be mentioned.

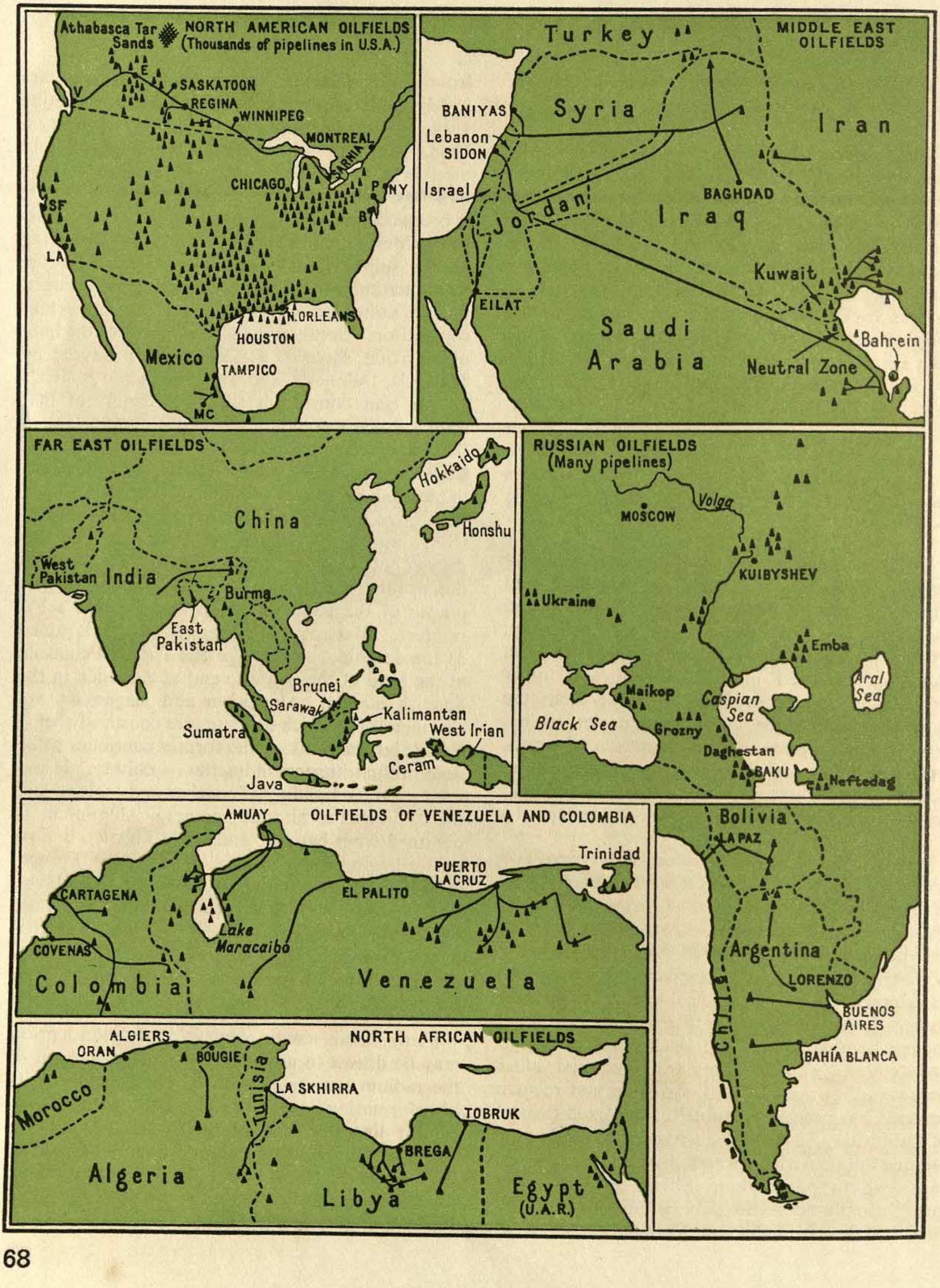
**Rocks** can be classified as igneous, metamorphic, and sedimentary. Igneous rocks have been formed by magma pushing its way from the interior towards the earth's crust. Magmas making their exit through the crust produce volcanic rocks, while those unable to reach the surface produce plutonic rocks, but both volcanic and plutonic are types of igneous rock. Surface rocks are exposed to the action of the weather, and fragments broken off by such agencies as frost, water, and wind are carried by rivers to the sea to be laid down as muds and clays and consolidated into shales and sandstones, when they are known as sedimentary rocks. When rocks, either igneous or sedimentary, have been changed by heat or pressure into rocks such as slates or schists, they are known as metamorphic rocks.

**Metallic deposits** are usually associated with igneous rocks. Some, such as magnetite and chromite, have crystallized from the magma and have sunk into it because of their greater density. Others, such as lead, silver, zinc, copper, and tin, have been formed in combination with other elements, by gases or fluids escaping from the magma and solidifying on reaching a cooler locality. Water plays a part in the transportation of metals. Surface water, for instance, may carry away weathered metalliferous rocks so that tin and gold are sometimes worked as alluvial or placer deposits.

**Iron ore** occurs in the United States west and south of Lake Superior, in Canada at Knob Lake, in the Ukraine of Russia, in the Lorraine of France, and in northern Sweden. Low-quality English ores occur in the Jurassic belt. A major discovery is that of north-western Australia. **Copper**, with its extensive use in the electrical world, has its main sources in the Western Cordillera of the U.S.A., in the northern Andes of Chile, in Canada, the Congo and Zambia. **Gold**, the standard of material values because of its resistance to corrosion and relative scarcity, has been responsible for the 'gold-rushes' of California, Australia, and Alaska, but today the famous South African Rand gives that country an easy lead in production. **Silver**, another noble metal, usually occurs in association with lead and zinc, and over half the world's supply is obtained from these deposits. Since lead and zinc are widely distributed, so is silver, but Mexico and the United States account for the largest quantities. **Lead**, occurring principally as the sulphide, and used in a multitude of ways, including storage batteries, cable covering, paints, and in building, is produced principally by the United States, Australia, Mexico, and Canada. **Zinc**, also occurring as the sulphide, and especially valuable in the manufacture of brass and galvanized iron, is mined in the same regions, with Peru an important competitor. South-east Asia accounts for the bulk of tin oxide, some 60 per cent being produced by Malaysia, Indonesia, and Thailand, while Bolivia's 18 per cent constitutes the chief export of that state. Some metals are particularly important in the manufacture of steels, and include **manganese**, **tungsten**, **chromium**, **cobalt**, **vanadium**, and **nickel**, the leading producers of which are Russia, China, the Congo, the United States, and Canada respectively, and it is significant that the Sudbury district of Canada, producing 80 per cent of the world's nickel, also accounts for the biggest output of the **platinum** group of metals as a by-product. **Mercury**, with a variety of uses, is mined as the sulphide, notably in the Istrian Peninsula at the head of the Adriatic and at Almadén in the Spanish meseta. **Aluminium** and **magnesium** are two metals for which new uses are constantly being found, but the bulk of the former continues to be used in the transport industries — railway, air and road — in the building of coaches and engines, and for castings for aircraft engines. Aluminium is obtained from bauxite, and while Jamaica is now the leading producer, Russia, the Guianas, France, the United States, Hungary, Guinea, Yugoslavia, and Greece contribute considerable amounts. Magnesium, obtained from its chloride, was produced principally by Germany before 1939 from the Stassfurt and Austrian deposits, but its chief source today is sea water.

Many metals remain unmentioned, but attention may be drawn to **uranium**, not merely because of the radium associated with it, but because of its transformation into other elements, with the resultant liberated energy made manifest to the world in the use of the atomic bomb. The chief sources are the Great Bear Lake region of Canada, the Katanga area of the Congo, and the American states of Colorado and Utah.

# Petroleum


NORTH AMERICAN OILFIELDS
(Thousands of pipelines in U.S.A.)
Athabasca Tar Sands
E
V
SASKATOON
REGINA
WINNIPEG
MONTREAL
SARNIA
CHICAGO
P
NY
B
SF
LA
N.ORLEANS
HOUSTON
Mexico
TAMPICO
MC
MIDDLE EAST OILFIELDS
Turkey
Syria
Iran
BANIYAS
Lebanon
SIDON
Israel
Jordan
BAGHDAD
Iraq
EILAT
Kuwait
Saudi Arabia
Neutral Zone
Bahrein
FAR EAST OILFIELDS
China
Hokkaido
Honshu
West Pakistan
India
Burma
East Pakistan
Brunei
Sarawak
Kalimantan
Sumatra
West Irian
Ceram
Java
RUSSIAN OILFIELDS
(Many pipelines)
MOSCOW
Volga
KUIBYSHEV
Ukraine
Emba
Aral Sea
Maikop
Caspian Sea
Black Sea
Grozny
Daghestan
BAKU
Neftedag
OILFIELDS OF VENEZUELA AND COLOMBIA
AMUAY
Trinidad
PUERTO LA CRUZ
EL PALITO
CARTAGENA
Lake Maracaibo
COVENAS
Colombia
Venezuela
Bolivia
LA PAZ
Argentina
LORENZO
BUENOS AIRES
Chile
BAHÍA BLANCA
NORTH AFRICAN OILFIELDS
ALGIERS
ORAN
BOUGIE
Tunisia
LA SKHIRRA
Morocco
TOBRUK
BREGA
Algeria
Libya
Egypt
(U.A.R.)

# Petroleum

North America accounts for 32 per cent of world production of crude oil, the great bulk of it (29 per cent) from the United States. The Middle East comes next, for which Kuwait, Saudi Arabia, Iran, Iraq, and the Neutral Zone are the most prolific producers. The Russian Bloc accounts for 17 per cent, the great bulk of it from the U.S.S.R. Latin America accounts for 15 per cent, nearly three-quarters of it from Venezuela.

The chief source in **North America** is a belt of sedimentary rock to the east of the Rockies extending from Alberta to the Gulf Coast. Other basins occur in California, in the Rockies and to the south of the Great Lakes. Texas, California, and Louisiana are the leading states. Refining takes place on the oilfields, but also in areas of high consumption such as Chicago, St. Louis, Buffalo, Philadelphia, and New York, to which oil is transported by pipeline or tanker. Alberta is the leading Canadian province. Pipelines connect the fields with Sarnia and Vancouver.

The **Middle East** is a source of supply for Western Europe. Pipelines connect Iranian and Kuwaiti supplies to the head of the Persian Gulf for transport by tanker via the Suez Canal. Saudi Arabian and Iraqi oil reaches the Mediterranean coast by pipeline.

**Russia** has several widely separated fields, of which the Caucasian and Volga–Ural–Emba fields are the most important, the latter with over 70 per cent of the total production. Recent developments include the construction of pipelines to Eastern European countries. Oil also constitutes the leading Russian export to countries outside the Iron Curtain, about one-tenth of the total.

For **Latin America**, Venezuela, Colombia, Trinidad, and Peru serve as exporters. About 70 per cent of the big Venezuelan production comes from the Lake Maracaibo region. Colombian fields lie a long way from the coast and in this respect differ from those of Venezuela, Mexico, Ecuador, and Peru. Mexico and Ecuador are practically self-sufficient in oil, but Argentina, with a high rate of consumption, is an importer. Bolivian oil now reaches the coast by pipeline. Chile's oilfields occur in Tierra del Fuego.

**African** production now exceeds that of the Far East. Most of it comes from Saharan areas in Libya and Algeria. The fields lie relatively close to the coasts, whence the ensuing tanker voyage to Western Europe is comparatively short. There is therefore a considerable saving in transport costs over oil dispatched from the Middle East.

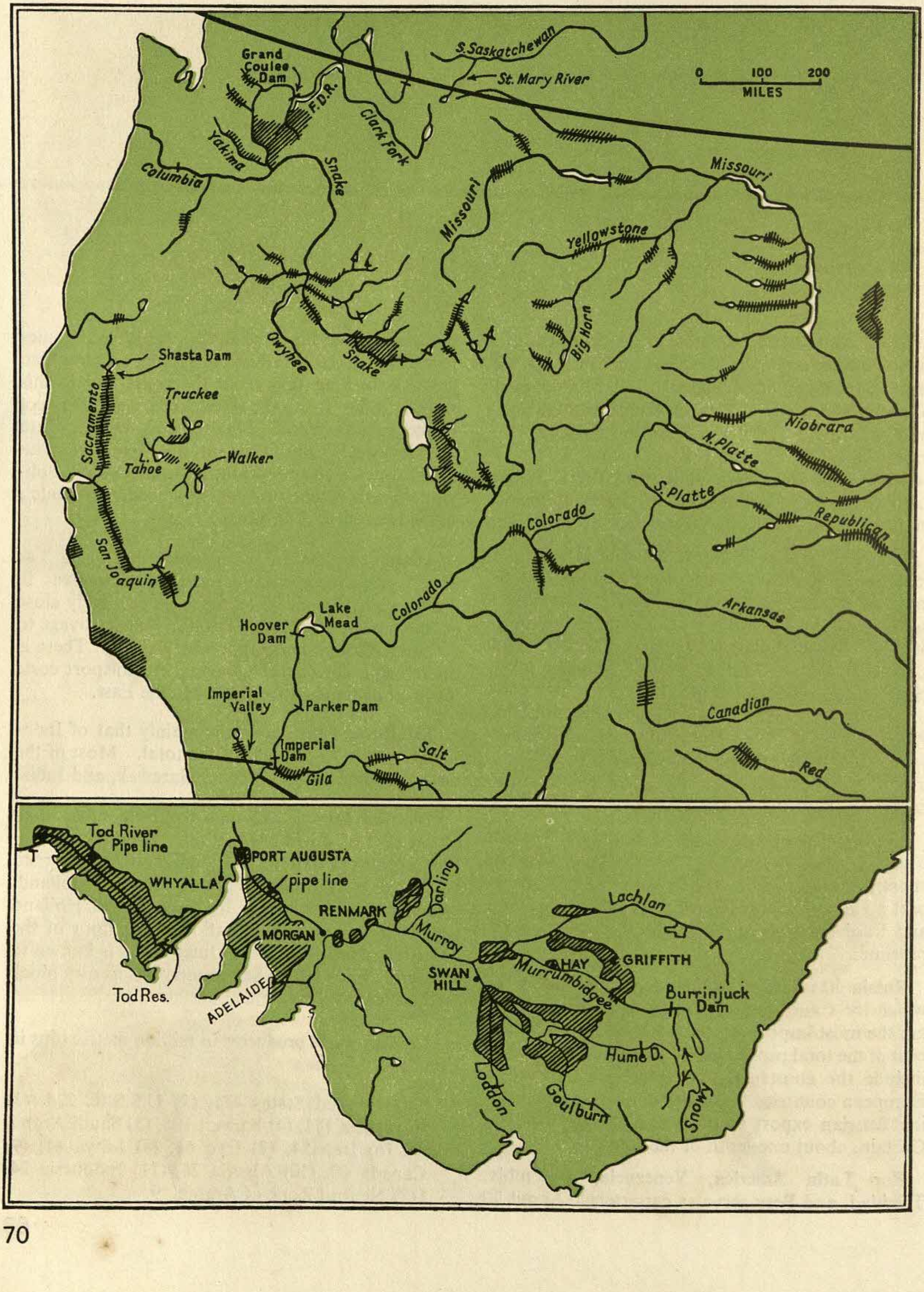
**Far Eastern** production is mainly that of Indonesia, about 70 per cent of the total. Most of the rest is contributed by Brunei, Sarawak, and India.

**Western Europe** accounts for little more than 1 per cent of world production. Even so it is important to the economy of the countries concerned — Western Germany, France, Austria, Holland, Italy, and Yugoslavia. Its discovery in Holland has sparked off its exploration in the floor of the North Sea into which the Dutch basin is known to extend. Each North Sea country has its own block of 'oil territory'.

**Leading world producers** in million metric tons in 1964:

(1) United States 425, (2) U.S.S.R. 224, (3) Venezuela 171, (4) Kuwait 106, (5) Saudi Arabia 86, (6) Iran 84, (7) Iraq 61, (8) Libya 41, (9) Canada 40, (10) Algeria 26, (11) Indonesia 24, (12) Neutral Zone of Arabia 19.

# Irrigation


Grand Coulee Dam
F.D.R.
S. Saskatchewan
St. Mary River
0 100 200 MILES
Clark Fork
Yakima
Columbia
Snake
Missouri
Missouri
Yellowstone
Big Horn
Owyhee
Snake
Shasta Dam
Truckee
Sacramento
L. Tahoe
Walker
Niobrara
N. Platte
S. Platte
Colorado
Republican
San Joaquin
Lake Mead
Hoover Dam
Colorado
Arkansas
Imperial Valley
Parker Dam
Canadian
Imperial Dam
Salt
Gila
Red
Tod River Pipe line
T
PORT AUGUSTA
WHYALLA
pipe line
Darling
RENMARK
MORGAN
Murray
Lachlan
SWAN HILL
HAY
GRIFFITH
Murrumbidgee
Burrinjuck Dam
Tod Res.
ADELAIDE
Hume D.
Loddon
Goulburn
Snowy

# Irrigation

Irrigation is the supply of water to land for crop production. It has been practised from early times in desert lands and lands with a dry season. Desert lands are deficient in humus but rich in mineral salts. Their cloudless skies favour plant growth.

**METHODS OF IRRIGATION.** Perennial irrigation from man-made reservoirs or wells is universal. Arid areas can be cultivated, crop failures averted in areas subject to unreliable rainfall, and in some climates several harvests can be made in a single season.

**Conditions favouring irrigation** include (*a*) the presence of mountains whose precipitation serves as a source of water for adjacent plains, e.g. the Himalayas for the Plain of Hindustan, (*b*) lakes which serve as natural storage basins, e.g. Maggiore, Como, and Garda for northern Italy, and (*c*) the presence of river gorges, e.g. the Boulder Canyon of the Colorado River.

West of the Mississippi in the **United States,** rainfall averages less than 20 inches except in the Pacific North-west. Heavy snowfall provides a substantial spring flow, however, and this is ponded back in reservoirs to ensure a regular supply. In the Intermontane Basins the most famous are the Grand Coulee and Hoover, but numerous irrigation schemes make use of the Snake, rivers flowing into the Great Salt Lake, and the Californian Valley. On the other side of the Rockies, the tributaries of the Missouri and Mississippi are used for irrigation of the High Plains. **Canada** has little need of irrigation water except in the southern prairie. In **Mexico**, water draining from the western Sierra Madre is used for irrigation of the Sonoran desert to the west and the plateau to the east, including that of the Laguna Basin (p. 39).

In **South America**, use is made of Andean rivers in the fruit-, maize-, and sugar-growing regions of Tucumán and Mendoza, in Chile's Valley of Paradise (p. 46) and in Peru's rainless desert. Schemes are envisaged in Peru for carrying water by tunnels through the Andes from the headstreams of the Amazon. On the other side of the continent, numerous small dams maintain water supplies in Brazil's drought-ridden north-east.

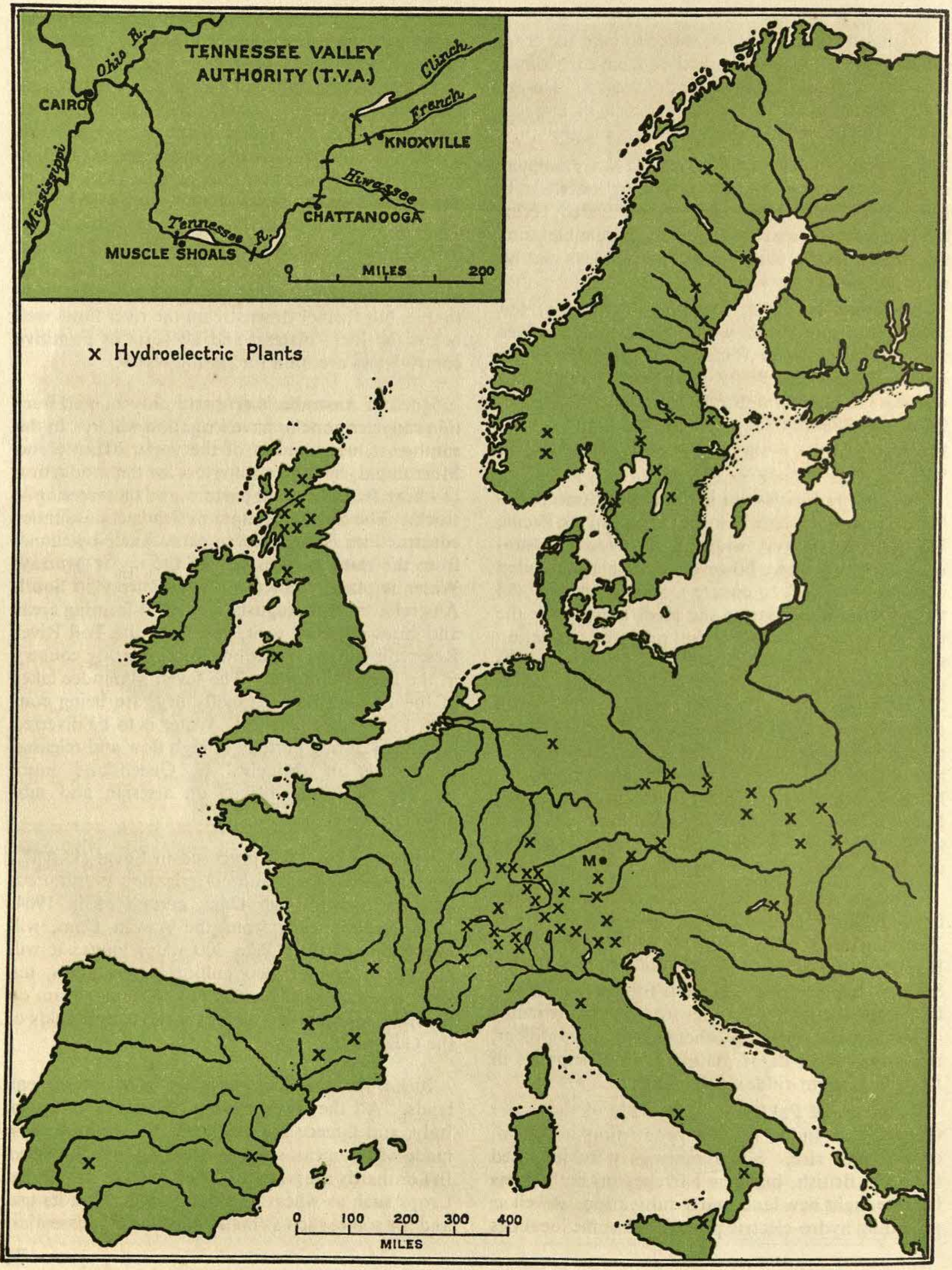
In **India and Pakistan** use is made of the upper Ganges and Indus for the production of wheat, cotton, and rice. Some schemes were inherited from the British, but new barrages on both rivers have brought new land under cultivation, as well as providing hydro-electric power. In some localities water is raised from the subsoil by wells. In southern India use is made of the Krishna, Cauvery, and other rivers, and both here and in Ceylon, rain water is collected in tanks, the name given to reservoirs, large and small, dammed by mud walls or cut into the solid rock. India has 60 million acres under irrigation, a greater area than that of any other country except China, and equal to 18 per cent of the area under cultivation. In north-east **China**, the bed of the Hwang Ho lies 1,000 feet above the Ningsia Plains (p. 22) and the construction of canals has been rendered comparatively simple, but further downstream the river flows well below the loess plateau and all sorts of primitive contrivances are used for raising water.

Much of **Australia** is arid and only a small fraction can ever hope to have irrigation water. In the south-east, use is made of the upper Murray and Murrumbidgee and other rivers for the production of wheat, fruit, rice, and pasture, and the watering of stock. The Snowy Mountains Scheme, now under construction, is designed to carry water by tunnel from the rainy eastern side of the upper Murray. Water is piped from the lower Murray in South Australia to Port Augusta for use in farming areas and cities adjacent to it, and from the Tod River Reservoir for the wheat and sheep-rearing country of the Eyre Peninsula. The seven Menindee lakes of the Darling Basin, usually dry, are being converted into storage lakes. Water is to be diverted into them during periods of high flow and released in periods of drought. In Queensland more reliance has to be placed on artesian and sub-artesian water.

Irrigation has been practised in **Egypt** (U.A.R.) since Biblical times. Flood irrigation is still used, but the Aswan High Dam, completed in 1964, 15 miles upstream from the Aswan Dam, will eventually create a lake 300 miles long. It will provide water for two million desert acres, ten times as much as at present. The Sennar Dam on the Blue Nile supplies water for the cotton-fields of the Gezira.

In **Europe**, the chief needs are in Mediterranean lands. All the fruit-growing coastlands of Spain, Italy, and Greece are irrigated. In Aragon use is made of Pyrenean streams draining into the Ebro. In Lombardy use is made of the Po and its tributaries. Crops such as wheat and flax benefit from its use, and for some, such as maize and rice, it is essential.

# Hydro-electricity



# Hydro-electricity

Electricity can be generated by steam or falling water. For the former, referred to as thermal electricity, some form of fuel is necessary such as lignite, coal, or petroleum. For the latter, known as hydro-electricity, a regular flow of water and a steep descent are required. Where lakes occur they serve as natural storage basins. Glaciers and snowfields store winter precipitation. A forest cover traps surface water and fosters an even distribution. Dams are built to make artificial reservoirs. A river gorge provides an ideal site. Where the gradient is gradual and the banks gentle, the lake tongues a long way upstream but because of its extensive surface area is subject to greater evaporation.

**USES OF ELECTRICITY.** Electricity is used as power for driving machinery in factory, mine, and on the farm. In certain cases it is used where heat is required, as in the production of ammonia, calcium carbide and certain alloys, and in others where it forms part of the chemical operation, such as the extraction of aluminium and magnesium and in the refining of copper and zinc.

**WORLD DISTRIBUTION OF HYDRO-ELECTRICITY.** **Canada** makes little use of her coal, partly because of its location in the eastern Rockies and on the Atlantic seaboard, but mainly because of her enormous hydro potential. Ninety-five per cent of all electricity produced is hydro. In all but the Atlantic Provinces it is the chief source of power. Quebec has the highest potential and is the most highly developed, especially along the edge of the Canadian Shield where it is used in pulp, paper, and aluminium production.

The **United States** has a high potential and is developed along the St. Lawrence Seaway, on the Tennessee headstreams of the Appalachians, and in certain parts of the West, as instanced by the Coulee and Boulder dams. On the other hand she has large reserves of coal, with some of the inferior types of the central plains more suitable for the generation of electricity than other uses. As a result only one-fifth of United States' production is hydro.

**Western Europe** is another highly industrialized region, and in some countries possessing little coal but ample potential water-power, hydro-electricity is virtually the only source of power, e.g. **Norway**, **Sweden**, and **Switzerland**. France and Italy have Alpine mountains within their frontiers. **France** makes use of the Alps and the Pyrenees, but with plenty of coal in the north-east, thermal and hydro stations make an equal contribution. **Italy** has no coal, so that all thermal plants must use imported fuel. Hydro-power has been increasing to reach 60 per cent of the total. **Spain** is even more dependent, with 70 per cent hydro. Power in **West Germany** is mainly thermal.

With the greater part of **Asia** largely agricultural, the demand is either too small or financial resources too meagre for its development. Russia and Japan are important exceptions. **Russia**, with considerable potential, continues to build big hydro stations. **Japan** is also highly industrialized. A little under half her total production is hydro. India and China have enormous potentials. **India** has developed power in the Himalayas and elsewhere. Even so, only one-tenth of her supplies is hydro. **China** is even less developed, but with an enormous labour force and industrial aspirations, progress could be rapid.

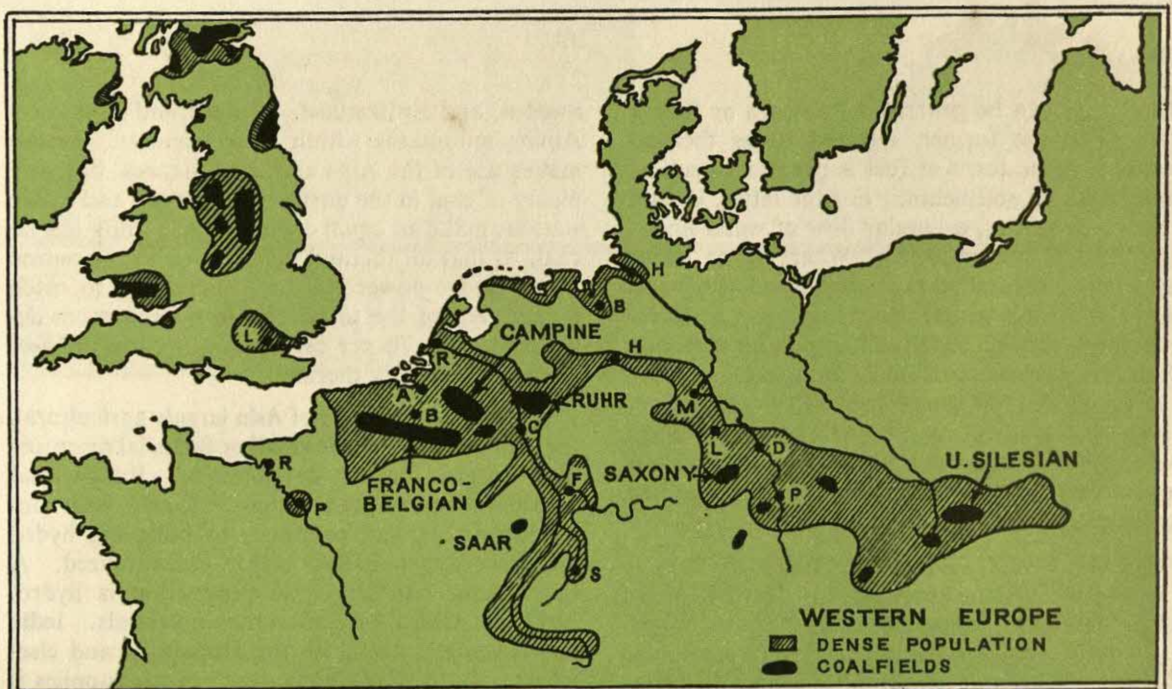
**Africa** possesses the greatest of all untapped resources, especially in the central zone where the Congo and its tributaries await exploitation. Use is made of the headstreams of the Congo in the copper belt of Katanga–Zambia for the electrolytic refining of copper and other metals, and on the Zambesi at Kariba (p. 34) for the supply of power to Zambia and Rhodesia. In Ghana the Volta is being dammed at a point not far from the sea, and in the U.A.R. the Nile at the Aswan High Dam (p. 38). Both schemes will provide irrigation water as well as power.

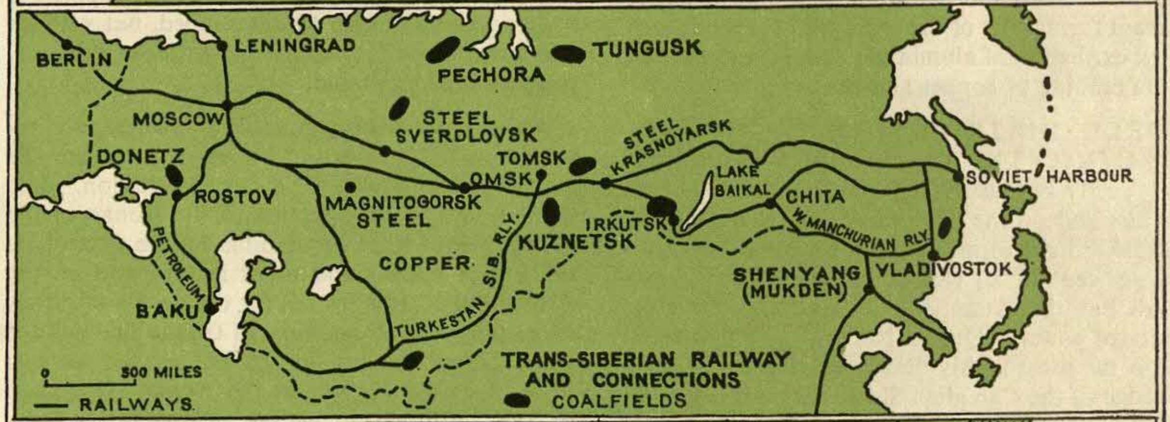
Potential in **South America** is largely confined to the Brazilian Plateau and certain parts of the Andes, such as those of central Colombia and the eastern ranges of Peru. Brazil makes use of the Grande and other rivers where they make their descent to the Atlantic coastal plain.

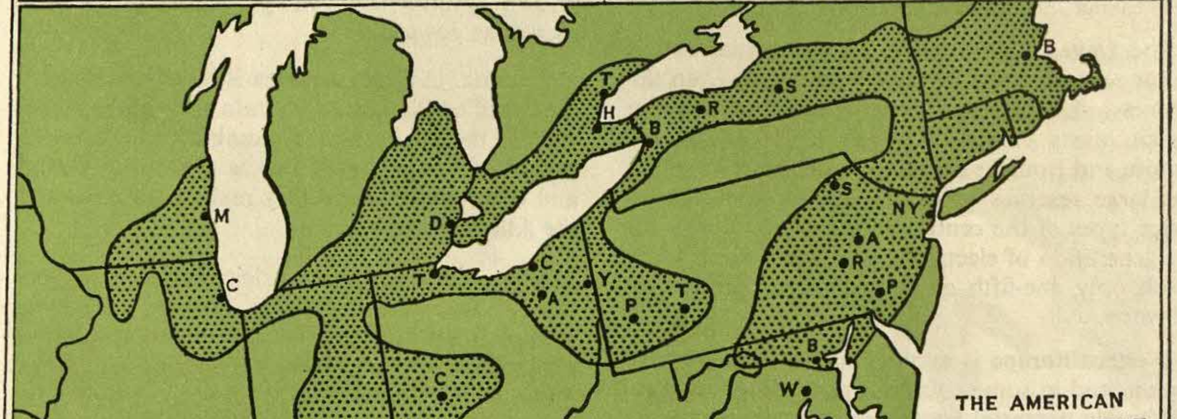
Most of **Australia's** electricity is thermally generated. Tasmania is better served with hydro stations than other states. Mainland schemes include those of the Snowy Mountains and Kiewa River of the south-east.

**New Zealand** relies largely on hydro-electricity.

# Manufacturing Regions







# Manufacturing Regions

The **rise of industry** in Western Europe and North America can be traced back to the early eighteenth century when inventions such as Kay's fly-shuttle, Hargreaves's spinning jenny, and Cartwright's water-power loom had the desired effect of increasing woollen output at reduced costs, and to Watt's steam-engine which was able to use the same steam over and over again for turning wheels and driving hammers. England was fortunate in having immense coal and iron reserves, which were rapidly exploited, and capital acquired through her thriving commerce. The Industrial Revolution which began in England soon spread to the Continent and to the New England States in spite of Acts of Parliament forbidding the export of machinery. Access to coal and iron has obviously been a major factor in the continued prosperity of these lands, but as these minerals occur in almost every climatic region, it may be that the invigorating climate of the temperate zones in producing active and inventive peoples with the ability and initiative has been just as vital. Some of the world's largest waterfalls occur outside temperate latitudes, but it is in the temperate lands that hydro-electricity is most fully used.

**EUROPE.** Generally speaking, Britain's major industries (cotton, wool, linen, steel, shipbuilding) have developed in close proximity to her coalfields. On the Continent, the coalfields which extend from northern France to Silesia are the scene of similar activities (textiles, steel, chemicals, glass). The Rhine has facilitated the import of raw materials and export of manufactures, so that Belgium and Holland, at its mouth, have the densest industrial populations on the Continent — 776 and 929 per square mile respectively. France possesses only one major field, the western end of the Franco–Belgian centred on Lille, but is fortunate in possessing the largest iron-ore reserves of Europe (p. 66). Other ironfields are those of Swedish Lapland and the Jurassic formations of Britain. Outside the coalfields are regions making considerable use of hydro-electricity, notably Switzerland and Italy.

**NORTH AMERICA.** The introduction of water-power in New England for the manufacture of cotton by such men as Slater and Lowell — the immigrant Slater is said to have assembled machinery from memory of machines used in England — caused towns to spring up almost overnight — Lowell, Lawrence, Holyoke, for example — and soon spread southwards to such places as Columbia and Chattanooga. Following England's lead, steam-power began to replace water-power and the building of railways made the demand for steel still greater. With the introduction of Bessemer's steel furnace, steel became the key industry after 1860, and steelworks were built at Pittsburgh and along the shores of Lake Erie, all of which acquired greater impetus with the discovery of the Lake Superior iron-ore deposits (p. 66). The discovery of oil in Pennsylvania led to its rapid exploitation and by 1870 it became a major export. Railway connections to the Great Plains were responsible for the development of a huge meat-packing industry. Today the United States is the greatest of all manufacturing countries, the greatest activity occupying a broad belt from Chicago to the Atlantic seaboard, but also in such centres as Los Angeles and San Francisco. Canada has benefited in no small measure from proximity to her neighbour.

**JAPAN.** Up to the year 1868 entry into Japan was forbidden, but suddenly foreign experts were invited by the hundred, factories and steelworks sprang up like mushrooms, and by 1937 Japan ranked fifth among the nations in international trade. In view of her limited resources her achievement was remarkable, as vast supplies of raw materials had to be imported. She was able to do this by selling large quantities of textiles (an industry which dwarfed all others) and products of light industries, at cheap prices, made possible by a cheap labour supply.

**RUSSIA.** The most spectacular of progress is that made by Russia. Soviet scientists claim that Russia has 57 per cent of the world's coal deposits, 59 per cent of its oil, and 41 per cent of its iron ore. Among its great steelworks are those of Magnitogorsk, Chelyabinsk, and Sverdlovsk. The eastern region accounts for half the coal output, 70 per cent of the oil, and 47 per cent of the steel.

**CHINA.** China, too, is fast becoming an industrial nation. Manchuria produces most of the coal and steel. Cotton manufacture, which is concentrated at a few centres such as Shanghai and Tientsin, is being decentralized.

**INDIA.** India is another Asiatic country which is making use of its mineral resources and water-power. Great strides have been made in the steel and engineering industries. Textiles are a valuable export.

# Questions

1. Define (*a*) latitude, (*b*) longitude, (*c*) Great Circle. If it is noon at Greenwich, what is the local time at a place 30° W. and at one in 30° E.? What is the longitude if local noon occurs at 6.40 p.m. G.M.T.?
2. What is the Date Line and why is it necessary?
3. With the aid of diagrams, explain (*a*) why a place in 35° N. has longer daylight than darkness on June 21, (*b*) why a place in the Northern Hemisphere is warmer in summer than in winter.
4. What was the Alpine Storm and what mountains did it form?
5. 'Volcanoes cannot be regarded as an ultimate evil.' Discuss.
6. What is a rift valley? Quote some examples.
7. In what ways does a youthful valley differ from one in old age? Account for the differences.
8. Explain what you understand by (*a*) pot-hole, (*b*) alluvial fan, (*c*) subsequent river, (*d*) beheaded river, (*e*) sedimentary rock, (*f*) igneous rock.
9. How are sand-bars and deltas formed? To what extent has man made use of deltas?
10. 'Lakes are transient features of the earth's crust.' Discuss.
11. State three ways in which lakes have been formed. What is their value to man?
12. What is a hanging valley? How were hanging valleys formed? To what use are they put?
13. Comment on features typical of granite scenery in temperate lands. Discuss the human geography of one granitic region.
14. How does Carboniferous limestone scenery differ from that of Jurassic limestone?
15. What is loess? Discuss its distribution in Eurasia.
16. What conditions favour soil erosion? Illustrate your answer by reference to the United States. What steps can be taken to reduce it?
17. Contrast the configuration of a fiord with that of a ria and account for it. What kind of populations line their shores?
18. Explain why (*a*) central Chile receives most of its rainfall in July while Algeria receives most in January, (*b*) northern Australia has a higher rainfall in January than July, (*c*) south Argentina is drier than the South Island of New Zealand, (*d*) tropical deserts occur on western sides of continents, (*e*) Java has a heavy rainfall throughout the year.
19. Discuss the effect of ocean currents on climate. Give instances.
20. Describe the characteristics and importance of the continental shelf, with special reference to any one continent.
21. Why were Europeans slow to settle in the Congo Basin?
22. How have geographical conditions affected the mode of human life in (*a*) the hot, wet forest of Africa, (*b*) the hot grasslands of Africa?
23. Compare the adaptation of animal life in the savanna with that in the equatorial forest.
24. Describe one example of a people who live by collecting and one example of nomads.
25. In what ways has man made use of deserts?
26. Explain why Patagonia, Iran, and Western Australia are deserts.
27. Write notes on (*a*) pampas, (*b*) llanos, (*c*) veld.
28. What climatic conditions suit the orange? Discuss its world distribution and the methods employed in its cultivation.
29. What regions have (*a*) summer drought, (*b*) summer rainfall? Explain.
30. What plants have been successfully introduced into Mediterranean lands? Discuss.
31. Discuss the world distribution and marketing of wheat.
32. Name the chief countries into which cotton has been successfully introduced. Indicate the conditions most suitable to the shrub and the difficulties connected with its cultivation. Name the chief cotton-manufacturing regions in the world.
33. Discuss the following: (*a*) Argentina is the greatest exporter of maize, but the U.S.A. is the largest producer, (*b*) the rearing of the silkworm is largely confined to the Far East, (*c*) rice is the chief cereal of the monsoon countries, but many have little left over for export.
34. Account for the distribution of coniferous forests. Discuss the methods employed in transporting timber to the coast in different countries.
35. In what ways would a photograph of a section of a hot wet forest differ from that of one of a coniferous forest and for what reasons?
36. Describe and account for the climate of British Columbia. Name one region in the Southern Hemisphere with a similar climate. Discuss the type of agriculture in both.
37. Discuss the conditions which produce different types of climate in Chile.

# Questions

38. Is the Arctic likely to become the flying crossroads of the future? Discuss its possible effects on present air routes.
39. Discuss the use of the Suez Canal by Britain and of the Panama Canal by the U.S.A.
40. Select two centres of the iron and steel industry in the United States. Discuss sources of raw materials and the routes taken to reach them.
41. In what areas is sugar cane grown? What difficulties hamper its successful cultivation and what efforts are made to overcome them?
42. Select two plants, other than cereals, which have been successfully transplanted in other parts of the world and discuss the methods used in their cultivation.
43. With the aid of sketch-maps, describe the location of one extensive ironfield in each of the following: (*a*) United States, (*b*) France, (*c*) England, (*d*) Sweden. Indicate the movement of the ore in two of these.
44. Discuss the distribution and transport of petroleum in either North America or Asia.
45. In what climates is irrigation most practised? Discuss the use of irrigation water in either Asia or South America.
46. What features of relief and climate are most suitable in the development of a river for water-power? Name some hydro-electric systems in North America.
47. 'Certain parts of Africa, South America, and Asia offer great possibilities for the establishment of hydro-electric systems, yet limited use has been made of them.' Discuss.

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